A Dissertation On

"EFFECT OF IAYT (INTEGRATED APPROACH OF YOGA THERAPY) ON MOTOR NERVE CONDUCTIVITY IN SPASTIC HEMIPLEGIC MEN"

Submitted by

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The Institutional Ethical Committee of Government Yoga & Naturopathy Medical College and Hospital, Chennai reviewed and discussed the application for approval of "EFFECT OF IAYT (INTEGRATED APPROACH OF YOGA THERAPY) ON MOTOR NERVE CONDUCTIVITY IN SPASTIC HEMIPLEGIC MEN", project work submitted by Dr. R. Vidhyalakshmi, 2nd year M.D.Yoga, Post graduate, Government Yoga and Naturopathy Medical College and Hospital, Chennai.

The proposal is APPROVED.

The Institutional Ethical Committee expects to be informed about the progress of the study and adverse drug reactions during the course of the study and any change in the protocol and patient information sheet/ informed consent and asks to be provided a copy of the final report.

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LIST OF ABBREVIATIONS USED

IAYT	Integrated Approach of Yoga Therapy
MNC	Motor Nerve Conduction
BMI	Body Mass Index
CG	Control Group
DBP	Diastolic Blood Pressure
EG	Experimental Group
HR	Heart Rate
DoP	Double Product
NSP	Nadishodhana Pranayama
SBP	Systolic Blood Pressure
NCS	Nerve Conduction Study
RPP	Rate Pressure Product
DRT	Deep Relaxation Technique
PP	Pulse Pressure
SNS	Sympathetic Nervous System
PNS	Parasympathetic Nervous System
LMN	Lower Motor Neuron

ABSTRACT

Background: Hemiplegia, or paralysis of one side of the body, is caused by injury or illness (for example, a stroke), and leads to other disabilities. People with hemiplegia are limited physically in their daily activities. This limitation affects their social well-being and thus can lead to depression. This study was planned to evaluate the effect of IAYT on the changes in motor conductivity in spastic hemiplegic men.

Methods: A total of seventy-five subjects, mean aged (48.04±11.28) were randomly assigned into two groups after satisfying the inclusion and exclusion criteria. Experimental group (EG, n=40) and Control group (CG, n=35). Both groups were assessed at baseline and after 56 days for MNC. During these 56 days the experimental group practiced Sushma Vyayama, Nadishuddhi pranayama, AUM chanting and DRT once daily and no intervention for control group. Finally experimental group (n=33) and control group (n=31) completed the study.

Results: The Experiment group showed significantly improvement in the Median Nerve Conductivity ($p<0.02$)and Deep-peroneal Nerve Conductivity ($p<0.05$), using Unpaired t-test, whereas no significantly improvement ($p>0.05$) in the Motor Nerve Conductivity of Median and Deep-peroneal nerve , in the control group. Yoga group patients showed a significant ($P<0.05$) reduction in the resting cardiovascular parameters such as SBP from 122.1±14.53 to 117.6±10.23 mmHg, RPP from 9525±1160 to 9178±835 bpm-mmHg and DoP from 5403±1832 to 4748±1137 bpm- mmHg.

Interpretation and conclusion: 56 days practice of IAYT in Spastic Hemiplegic men showed dominance of parasympathetic activity and suppression of sympathetic activity.

Key words: Spastic Hemiplegic Men; Sukshma Vyayama; Nadi Shodhana Pranayama; Deep Relaxation Technique; Motor Nerve Conduction; Autonomic function.

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INTRODUCTION

1.0 INTRODUCTION

Hemiplegia, or paralysis of one side of the body, is caused by injury or illness, and leads to other disabilities. Hemilpegic have a limited daily physical activities which affects their social well-being and leads to depression **(Zenobia, C Y, Chan, 2012).** In 2007, WHO estimated that there are more than 600 million people with disabilities worldwide (World Health Organization, 2007), and hemiplegia is one of the more common disabling conditions and may be caused by neurological problems like stroke and brain injury.

Pedretti . et.al., (2001) defined Hemiplegia as the paralysis of one side of the body.

Savinelli, R. et.al., (1978) reported that Hemiplegia is caused by injury to the brain or due to some disease which leads to difficulties in locomotor functioning, cardiopulmonary function, and sensory functioning**.**

Kong, K. H, & Yang, S. Y, (2006) found that these difficulties affect their activities in daily living and thus have a negative impact on the quality of their life .

Lazaridou, A. et.al., (2013) explained that the experience of stroke can have a negative impact on both psychological and physical health and on quality of life. They suggested that Yoga practices were one of the effective therapies that have been used for patients with a variety of ailments.

Yoga is the India's oldest tradition which harmonizes the mind, body and soul. It has evolved over 5,000 years ago, which has moral and ethical precepts, mental attitudes, and physical practices **(Feuerstein G, 2000)**

The word Yoga means ‘unity’ or oneness and is derived from the Sanskrit word **YUJ** which means ‘to join’. Yoga unites the individual consciousness with the universal consciousness to attain the supreme reality. It is the science of right living and works on all aspects of the person: the physical, mental, vital, emotional, and spiritual.

Swami Satyananda Saraswati said, “Yoga is not an ancient myth buried in oblivion but the most valuable inheritance of the present. It is the essential need of today and the culture of tomorrow” **(Swami Satyananda saraswati, 2002, P-1)**

Goyeche, J R M, (**1979)** suggests that Yoga and mindfulness can be regarded as a main form of alternative medicine therapy.

Schmid, A A. et.al., (2014) observed that therapeutic yoga intervention may improve multiple aspects of physical functioning after stroke and may be complementary to traditional rehabilitation .

Immink, M A. et.al., (2014) concluded that the yoga intervention had a significant improvement in quality of life associated with perceived motor function and improvements in perceived recovery approached significance. They also found that the memory significantly improved after yoga intervention, and those in the Yoga intervention group exhibited decreased state and trait anxiety.

Schmid, A A. et.al., (2012) conducted a pilot study where they reported that the Yoga group data demonstrated significant improvement in balance BBS (Berg Balance Scale) and FoF (Fear of Falling). They concluded that yoga intervention based on a group performance has potential in improving multiple post stroke variables for people with chronic stroke.

These disabilities, make them to face difficulties in their daily lives, such as depending on others for their daily needs. They may feel insecured, angry, depressed, and guilty while facing the challenges. This is true with men, on whom the masculinity is projected, including the attributes of power, control, strength, independence, responsibility and dominance. This image may hinder men from expressing their difficulties in dealing with their disabilities **(Tager, D. et.al., 2006)** As counselling is found to reduce depressive moods and facilitate communication **(Courtenay, 2001)**

A study conducted on the effect of Yoga and exercise in depression and anxiety in people with post stroke disability revealed greater improvements in the mood of post stroke **(Chan, W. et.al., 2012)**

All the above studies suggested to conduct a detailed study on the effect of Yoga on Hemiplegia and as such there has been no study conducted yet on the effect of yoga on motor nerve conductivity, which motivated us to conduct this study for the betterment of hemiplegic patients.

AIM

&

OBJECTIVES

2.0 AIMS AND OBJECTIVES

2.1 Aim:

The aim of this study was to assess the effect of IAYT on changes in the Motor nerve conductivity in Spastic Hemiplegic Men.

2.2 Objectives of the study:

The objectives of the present study are:

- To record the Motor Nerve Conductivity in Median nerve and Peroneal nerve before and after intervention
- To record the Resting Cardio-respiratory parameters before and after intervention
- To compare the Motor nerve conductivity and Resting Cardio-respiratory parameters before and after intervention

REVIEW

OF

LITERATURE

3.0 REVIEW OF LITERATURE

3.1 Hemiplegia

Hemiplegia is the condition where one side of the body is paralyzed or weakened due to stroke. It occurs when the flow of blood to the brain is disturbed or obstructed, due to which a part of the brain dies. Hemiplegia is caused by the damage to central nervous system (brain and spinal cord): where the orders of movements are not transmitted to the muscles. In addition to motor problems, memory or sensitivity may also get affected.

Stroke is defined by the World Health Organization (WHO) as the "rapidly developing clinical signs of focal (at times global) disturbance of cerebral function, lasting more than 24h or leading to death with no apparent cause other than that of vascular origin" **(Hatano, S, 1976)**

Paralysis may affect any one part (e.g. the arm, the leg) or the entire side of the body. Severe or complete loss of muscular functions on one side of the body will be present in this condition. When the right side of the brain is affected, the left side of the body is paralyzed (and vice versa). Hemiplegia may be both congenital (since birth) or acquired (from other illnesses such as a Stroke). The two main causes of stroke are: ischaemia, or the lack of blood supply to the brain; and haemorrhagic, which results from a fissure in an intracranial artery **(Sims, N R, & Muyderman, H, 2009)**

In stroke survivors, these events may lead to a long-term disability, age-related cognitive impairment and poor or loss of memory **(Falcone, G J.et.al., 2014)**, and which has a deep emotional and socioeconomic impact on the patients and their families and also on the health services **(Feigin, V L. et.al., 2003)**

Langhorne, P. et.al., (2009) found that stroke resulted in the difficulty of motor activities and which results in the limitation of their movements.

In addition, non-cognitive neuropsychiatric symptoms may occur after stroke, such as depression, anxiety, emotional lability, apathy and post-stroke fatigue

(Hackett, M L. et.al., 2014)

Stroke also causes other health issues and impairs the quality of living

(Garrett, R. et.al., 2011)

In the stroke patients the peripheral nerves are affected both morphologically and electro physiologically on the paretic side. The distal latency is prolonged and they have a slow motor conduction velocity of the tibial nerve and reduced amplitudes of the median and ulnar nerves on the paretic sides when compared with that of the non-paretic sides. The median and sciatic nerve values were smaller on the paretic sides as compared to the non-paretic sides. (**Uğurlu, F G. et.al., 2015)**

It is found that in the paralyzed leg of stroke patients there will be severe inversion of the ankle, with drop foot, which shows the altered common peroneal nerve conduction properties. In the deep peroneal nerve the motor nerve conduction latencies of the tibialis anterior muscle were longer in the paralytic side than in the sound side **(Nahariya, et.al., 2007)**

3.1.1 Hemiplegia Prevalence

A study conducted on the Incidence estimate and guideline-oriented treatment for post-stroke spasticity based on German statutory health insurance in 2009, revealed that 3.7 per 1000 persons had stroke. There were about 242090 insurants out of which 1263 of the (sample population) were admitted to a hospital for acute stroke in the year of 2009 **(Veronika Egen-Lappe, et.al., 2013)**

3.1.2 Hemiplegia Pathophysiology

Injury to the nerve pathway that provides loss of control of the muscles may occur on different occasions. The most common cause is stroke (Cerebrovascular Accident). It can have different origins: the interrupted or disturbed blood supply to part of the brain caused by a clot that blocks an artery or cerebral hemorrhage which results in oxygen deprivation in that region, which results in the death of nerve cells. Motor deficits are characterized by paralysis (hemiplegia), typically on the side of body opposite to the side of lesion. Interruption of blood flow only for a few minutes sets in a series of pathological conditions. (**O'Sullivan, 2007).**

Hemiplegia is set up very quickly but sometimes regresses more or less disabling sequelae. Trauma can also cause hemiplegia brutal and immediate. Hemiplegia which occur more gradually they are caused by brain tumors, infections (encephalitis and brain abscess).

Spastic hemiplegia is a neuromuscular condition of spasticity that results in the muscles on one side of the body being in a constant state of contraction. It is the "one-sided version" of spastic diplegia. It falls under the mobility impairment umbrella of cerebral palsy. About 20–30% of people with cerebral palsy have spastic hemiplegia. **[Cerebral palsy at eMedicine]**

Due to brain or nerve damage, the brain is constantly sending action potentials to the neuromuscular junctions on the affected side of the body. Similar to strokes, damage on the left side of the brain affects the right side of the body and damage on the right side of the brain affects the left side of the body. The affected side of the body is rigid, weak and has low functional abilities. The severity of spastic hemiplegia is dependent upon the degree of the brain or nerve damage. **(Brashear& Allison, 2010)**

There are many different brain dysfunctions that can account for the cause for spastic hemiplegia. Spastic hemiplegia occurs either at birth or in the womb. **(Tardieu, C. et.al., 1982) & (Tardieu, G. et.al.,1982) .** The cause can be all types of strokes, head injuries, hereditary diseases, brain injuries and infections.

Malformations of the veins or arteries in any part of the body can lead to spastic hemiplegia. The artery most commonly affected is the middle cerebral artery.

The spasticity occurs when the afferent pathways in the brain are compromised and the communication between the brain to the motor fibers is lost. When the inhibitory signals to deactivate the stretch reflex is lost the muscle remains in a constant contracted state. With spastic hemiplegia, one upper extremity and one lower extremity is affected, so cervical, lumbar and sacral segments of the spinal column can be affected**.[Cerebral palsy at eMedicine]**

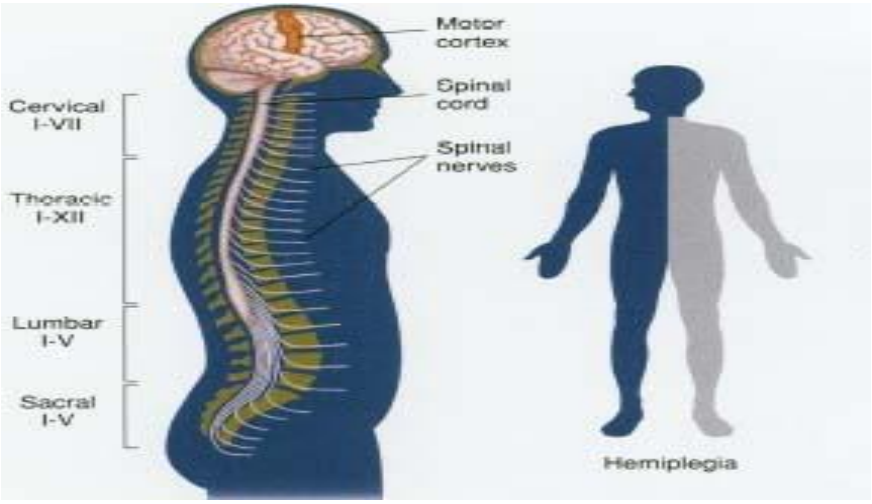
The muscle spasticity can cause gait patterns to be altered and jerky. The constant spastic state of the muscle can lead to bone and tendon deformation, further complicating the patient's mobility. Many patients with spastic hemiplegia are subjected to canes, walkers and even wheelchairs. Due to the decrease in weight bearing, patients are at a higher risk of developing osteoporosis.**[Cerebral Palsy~clinical at eMedicine]**

An unhealthy weight can further complicate mobility. Patients with spastic hemiplegia are a high risk for experiencing seizures. **(el-Abd, M A, Ibrahim, I K, March 1994)**

Oro-motor dysfunction puts patients at risk for aspiration pneumonia. Visual field deficits can cause impaired two-point discrimination. Many patients experience the loss of sensation in the arms and legs on the affected side of the body.**[Cerebral**

Palsy~clinical at eMedicine] Nutrition is essential for the proper growth and development for a child with spastic hemiplegia.

Figure :1 Pathophysiology of Hemiplegia



3.1.3 Pathogenesis

Damage to the pyramidal tracts produces impairment or loss of voluntary movement from interruption of the conduction of motor impulses.

3.1.4 Hemiplegia Diagnosis

Faced with a hemiplegic patient, the doctor performs a neurological exam to assess the extent of the invasion. It tests the presence of a Babinski sign by stimulating the outer edge of the sole from the heel to midfoot: if the person suffers from hemiplegia, the great toe by an extension, which is indicative a lesion of the pyramidal pathway.

There are situations where the diagnosis is not obvious because the hemiplegia may present with subtle signs such as clumsiness or fatigability of muscles on one side of the body. So the doctor performs a series of examinations, and in particular the operation of Barre highlighting deficits on one leg or one arm or both. In the case of an unconscious person, the hemiplegia was found from different specific maneuvers.

Imaging studies, CT or magnetic resonance imaging (MRI) can detect the causes (aneurysm, tumor embolism) cause brain damage. An electro encephalogram may give information about brain injury and their importance. A neuropsychological examination can identify possible cognitive impairment such as aphasia, common in cases of hemiplegia.

A nerve conduction study (NCS) is a medical diagnostic test commonly used to evaluate the function, especially the ability of electrical conduction, of the motor and sensory nerves of the human body. Nerve conduction studies are used mainly for evaluation of paresthesias (numbness, tingling, burning) and/or weakness of the arms and legs.

Fig: 2 Graphical representation of the Motor Nerve Conduction Velocity

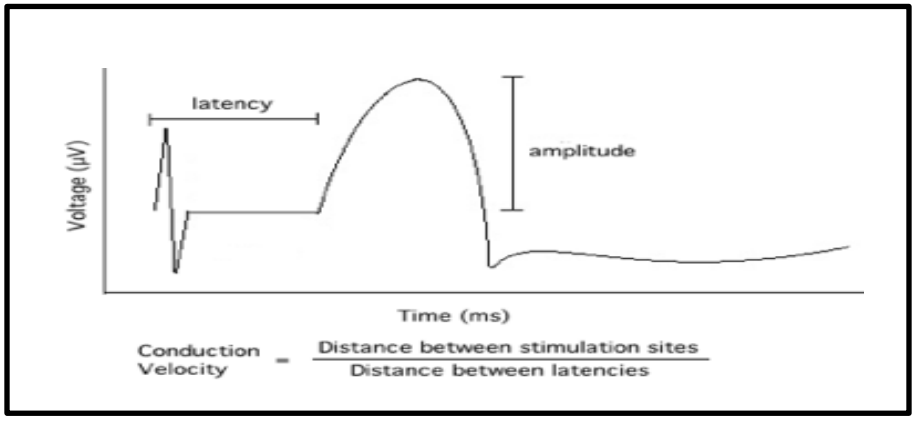


Fig: 3 Median motor nerve conduction

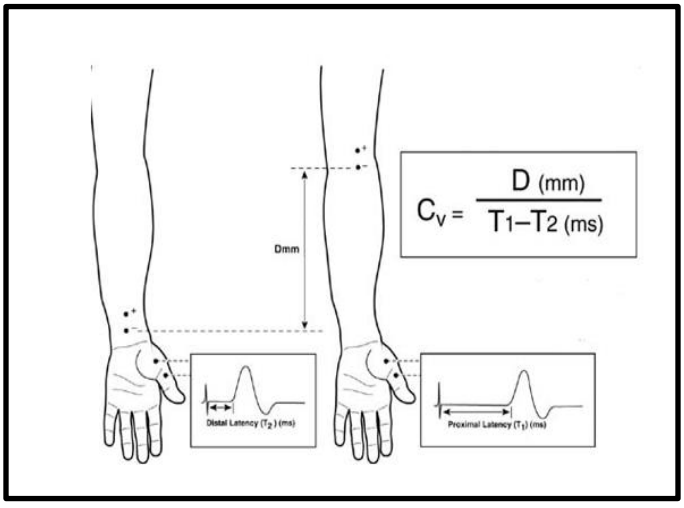
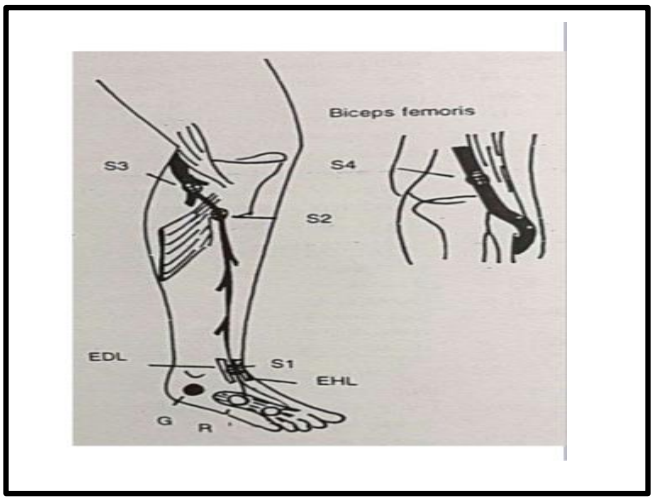


Fig: 4 Deep peroneal motor nerve conduction



3.1.3.1 MOTOR NERVE CONDUCTIVITY

Buschbacher, R M, (1999) suggested that the Median motor study is one of the most commonly performed tests in electro diagnosis. It has been extensively used in the research field as well as in clinical practice.

Data on peripheral nervous system function may be of use in providing diagnosis, description of the disease state, monitoring of median nerve disease using multiple studies, and rendering advice on prognosis and management based on the test results and the disease detected. **(Fisher, M A, 2002), (Katirji, B, 2002), (Aminoff, M J, 2003), (Asbury, A K,1954), (Fuglsang-Frederiksen, A, & Pugdahl, K, 2011)**

It is obviously preferable in a clinical setting to have reference data derived from a sample population that approximates, as closely as possible, the demographic characteristics of the patient being tested. **(Robinson, L R, Rubner, D E, 1994)**

The Western and Middle East countries have published many studies from normative data of the median nerve. **(Hennessey, W J. et.al., 1994), (Falco, F J. et.al., 1992), (Hennessey, W J. et.al, 1994), (Kumar, B R, & Gill, H S, 1985), (Correa Pérez, M, 1986), (Cochran, W G, 1977)**

According to a study conducted on Median Nerve Conduction in Healthy Nigerians: Normative Data, the reference range for median motor nerve velocity is 49.48 – 66.92 msec **(L F Owolabi, et.al., 2016)**

Uğurlu, F G. et.al., (2015) did an Ultrasonographic evaluation of the median and sciatic nerves in 33 hemiplegic patients after stroke out of which 18 were women and 15 were men. They found that prolonged distal latency and slowed motor conduction velocity of the tibial nerve as well as reduced amplitudes of the median and ulnar nerves were observed on the paretic sides when compared with those of the nonparetic sides (all $P < 0.05$). The median and sciatic nerve cross-sectional area values were found to be smaller on the paretic sides when compared with the nonparetic sides (all $P < 0.05$).

KOJI SHIGENO, (1972) did a study on hemiparesis patients due to Cerebrovascular disease with varying degrees and revealed the relationship of hemiplegic amyotrophy to severity of motor impairment which suggests that (in addition to the possible close proximity of the vasomotor and central trophic systems to the pyramidal tract) lower motor neurons, involved by upper motor neurons, may possibly induce denervation atrophy

Neurographic studies in hemiplegic patients with spastic hemiparesis after stroke done by **Ivan, G, Milanov, (1995)** on the motor conduction velocities, were evaluated in median, ulnar, peroneal and tibial nerves which revealed normal motor conduction velocities

Dr. Zainab, M M, Chatriwala1 et.al., (2016) conducted an observational study on the Common Peroneal Nerve Conduction Velocity (NCV) in Post Stroke Patients where the Distal latency were prolonged. The Motor NCV and CMAP amplitude were reduced in the affected lower limbs compared to the unaffected lower limbs. The study in stroke individuals also concluded that the spasticity of ankle plantar flexors and/or weakness of ankle dorsi-flexors could cause electrophysiological changes in the Common Peroneal Nerve.

K, Takebe, M G, Narayan, et.al., (1975) did a study on nerve conduction velocities of ulnar and peroneal nerves bilaterally in 27 hemiplegic patient where they found that the upper motor lesion affects the function of the lower motor neuron. The causes demonstrated were, the lower skin temperature, atrophic thinning of the fibers and other less plausible factors.

S, Chokroverty, and J, Medina, (1978) did Electrophysiological study on 13 hemiplegic patients and where they showed that Motor nerve conduction velocities of the ulnar and common peroneal but not the median nerves were substantially reduced in the affected limbs of hemiplegic patients. The reduction of skin temperature in the hemiplegic limbs was related to the slowing of conduction velocity of the common peroneal nerve.

Gender has a definite effect on NCS (Nerve Conduction Study) variables. The tests were done on JAVA RMS Aleron-201 series. **(Abhishek Kumar & Anjali Prasad, 2016)**

Thakur et.al., (2010) found an increase in all component of CMAP(Compound Muscle Action Potential) for male as compared to female and was statistically significant for ante-cubital fossa and right popliteal fossa.

The age factor had been negatively correlated to the amplitude in MNC conducted by **Huang et.al., (2009)**. This study also showed that the conduction velocity was slightly more in the upper limb than the lower limb which could be due to the length of the nerve.

Study conducted by **Shailja Tiwari et.al., (2015**) showed that as on increasing the temperature from 290 C to 390C there was significant increase in nerve conduction velocity by 1.0 to 1.4 m/second per degree rise in temperature.

3.1.4. CLINICAL FEATURES

Hemiplegia Sign

Hemiplegia caused by a lesion of the pyramidal tract. This is the main neural pathway that carries the motor orders. It is therefore a set of neurons involved in voluntary movement.

The pyramidal pathway begins in the brain at an area of nerve cells of pyramidal shape and joined with other nerve cells of the spinal cord. Pyramidal tract neurons then transmit their orders to LMN which carry them to the muscles. Before reaching the spinal cord, brain stem, the pyramidal tract changes sides. This explains that a lesion is localized on the side opposite the affected limb: left brain injury causes a right hemiplegia and vice versa.

Observed with different depending on the location of the injury.

- When the lesion in the brain cortex, this causes a disproportionate hemiplegia: the face and arms are predominantly affected.
- When the lesion is located in the white matter of the brain, this causes a proportional hemiplegia: arm and leg are affected similarly deficient.

A brainstem lesion, it causes a paralysis of one side of the body and involvement of the face on the other side.

Hemiplegia Symptoms

In some cases the lesions, arm and leg are affected, in others only the arm or only the face. When hemiplegia is partial and that movements are still possible, there is a decrease in muscle strength and mobility impaired, as manifested by clumsiness, trouble walking accompanied by a great tiredness and falls of one side. When hemiplegia is total, even the reflexes are abolished. However, the Babinski sign is present: when you touch the outside of the foot, it causes an extension of the big toe. In a healthy person, this stimulation leads to a bending of the big toe. Hemiplegia is accompanied by changes in muscle tone: the muscles are stiff and overly contracted any (spastic hemiplegia) or conversely soft and flabby (flaccid hemiplegia). On the face, the damage to the muscles can result in a drooping eyelid or an asymmetric smile.

Hemiplegia Other Symptoms

In addition to motor disturbances, hemiplegia is characterized by the appearance of other symptoms.

- Pain- There is pain associated with brain injury and localized pain in the affected limbs.
- Aphasia- People who suffer from hemiplegia, even though the process of thinking and developing ideas is held, are struggling to find words and articulate. In addition, they may have difficulty understanding the meaning of words they hear or read them.
- Disorders of the sphincters- A quarter of people with hemiplegia have sphincter disturbances resulting in either urinary incontinence or urinary retention, fecal incontinence is still.
- Sexual dysfunction- erection, ejaculation is compromised in many men with hemiplegia. Moreover, a decreased libido, especially at the beginning of the disability, is often found.

Hemiplegia Complication

The immobility of paralysis arising Member is responsible for complications that specialists in physical medicine and rehabilitation at trying to prevent the initial management. The main complication remains on the loss of autonomy: everything must be done to try to recover mobility as complete as possible.

Among the complications that can occur after hemiplegia

- Pain in joints of immobilized different: the shoulder is often affected with a stiffening of the muscles (spasticity) and local inflammation.

Moreover, the bones of people with hemiplegia are weakened and lose bone density (osteopenia) as the brain give rise to abnormal vascularization of bone. Finally, sitting in a wheelchair or bedridden status may promote pressure sores (skin necrosis at the points of support) and problems such as venous disorders of venous circulation, the risk of phlebitis and edema. The sphincter disturbances can cause infectious complications.

3.1.5 Conventional Management

3.1.5.1 Pharmacotherapy

A study conducted by **Feeney, D M. et.al., (1993)** on Nor-adrenergic pharmacotherapy, intra cerebral infusion and adrenal transplantation showed improvement in the functional recovery after cortical damage which revealed that the widespread reduction of glycolytic and oxidative metabolism, produced by focal cortical injury, is normalized by the same treatment which alleviates symptoms and is worsened by drugs which exacerbate deficits. The data support the hypothesis that providing SRE (symptom relevant experience) during a period of enhanced NA (noradrenergic) synaptic activity produces an enduring functional recovery after cortical injury by attenuating remote functional depression.

Pharmacotherapy administered to enhance the Cognitive and Motor Recovery following Stroke were especially the antidepressants, acetyl-cholinesterase inhibitors and memantine for aphasia. But, clinical trials are needed to address the shortcomings of stroke management. **(Xabier Beristain, 2015)**

3.1.5.2 Surgical Approach

Surgical approaches in case of Hemiplegia include tendon transfer, muscle lengthening, and arthrodesis. These procedures are considered to be permanent to fix the solutions: in case of arthrodesis, where the overall range of movement is reduced. Achieving a more functional hand position and improving the appearance or hygiene of the arm and hand are the goals of the treatment. Robust studies of long-term outcome are only few that are available, but there is evidence of benefit **(Smitherman, J A. et.al., 2011), (Eliasson, A C. et.al., 1998), (Skold, A. et.al., 1999)**

The long-term benefit in terms of function and cosmesis from the patients aspect were perceived by many Research scholars. **(Skold, A. et.al., 2007), (Johnstone, B R. et.al.,2003**)

3.2.1 Spastic Hemiplegia and Autonomic Dysfunction

Patients with various cerebrovascular diseases commonly have disturbances of the autonomic nervous system. The damage occurs in the fronto-parietal cortical areas and in the brain stem mainly in the central autonomic network. It may be also be because of disruption of the autonomic pathways. The autonomic pathway descends through the mesencephalon, pons, and medulla to the spinal cord from the hypothalamus. Abnormalities in heart rate and blood pressure regulation, reflects the cardiovascular autonomic dysfunction. Asymmetric sweating with cold hemiplegic limbs, reflects the

changes in the sudomotor and vasomotor regulatory systems. These are the most common clinical problems in case of stroke.

Some may have complaints like bladder and bowel dysfunction or incontinence and impotency after stroke. In the acute phase of stroke there occurs increased sympathetic activity resulting in Cardiovascular autonomic dysfunction and abnormal sweating. These changes may be irreversible attimes. This autonomic imbalance also contributes to abnormalities in the parasympathetic nervous system. Quantitative analysis methods are inevitable for detecting the autonomic dysfunctioning, because these disturbances are disabling and uncomfortable for the subjects. It may also be prognostically unfavorable. **(Korpelainen, J T. et.al., 1999)**

Juha T Korpelainen et.al., (2017) concluded that hyperhidrosis or profuse sweating on the paretic side of the body was observed in 55% of the patients at baseline, after 5 minutes of heating in 74%, and after 10 minutes of heating in 77%.

Hyperhidrosis observed throughout the body correlated with the severity of paresis, which is because of the reduced muscle tone, and the extensor plantar response. This sweating disturbance might be because of the lesion of a putative sympathoinhibitory pathway controlling sweating. The failure of this pathway could also be related to other manifestations of sympathetic hyperfunction, e.g., cardiac complications

3.2.2 Yoga and Health

Yoga is one of the six systems of Indian Vedic philosophy **(Darshan).** Maharishi Patanjali, rightly known as the **"Father of Yoga"**, compiled and refined various aspects of yoga systematically in his ***"Yoga Sutras"*** (aphorisms), wherein he advocated the eight-fold path known as **"Ashtanga Yoga"** for an all-around development of human personality. These include - **Yama** [moral odes],

Niyama [self-purification and study], **Asana** [posture], **Pranayama** [breath control], **Pratyahara** [sense control], **Dharana** [concentration], **Dhyana** [meditation], and **Samadhi** [super contemplation]. These are formulated on the basis of multifarious psychological understanding of human personality.

Other aspects of yoga philosophies are broadly classified into four streams namely Work, Worship, Philosophy, and Psychic control. "**Karma Yoga**," the path of work, promotes pleasure in labor without indulging in thoughts of success or failure. A free mind allows the task to be done in a skillful manner. "**Bhakti Yoga**," the path of worship, is a systematic method of engaging the mind in the practice of divine love. This attitude of love softens our emotions and tranquilizes our mind. "**Gyana Yoga**," the path of philosophy, is a systematic way of enlightening the mind about the realities of life by contemplation. This will strip off the garb of **Avidya** (ignorance) from our mind as it goes to its natural state of rest.

"**Raja Yoga**," the path of psychic control, is a systematic process of culturing the mind. It is based on the eight-fold path set by Patanjali.

Studies of neurological disorders, like epilepsy, have shown improvements attributed to yoga. However, it is important to recognize that behavioral modification and altered lifestyle accounts for the improvement in the outcomes.

A study carried out on 60 students doing their First-year MBBS were assigned to two groups: the yoga and control group (30 each). The yoga group practiced integrated yoga practices for 35 min daily for a period of 12weeks under the guidance of a trained yoga teacher. The control group were not assigned for any kind of yoga practice at all for stress management. It was found that the serum IFN- γ decreased with examination stress. Decreased serum IFN- γ levels is an indication of the decline in Cellular immunity. The decrease in serum IFN- γ was less significant in the yoga group than the control group which indicated a decline in cellular immunity with examination stress which was found to be more among the control group than the yoga group students. **(Gopal, A. et.al., 2011)**

The study by **Sirven et.al., (2003)** exhibited the percentage of individuals who benefited from yoga was among the highest in all CAM (Complementary and Alternative Medicine) modalities.

Bastille et.al., (2004) demonstrated the benefits of yoga among post-stroke patients.

In the study conducted by **Oken et.al., (2004)** they concluded that yoga and aerobic exercise were effective in relieving fatigue in MS patients.

One study has shown that psychological benefits of an aerobic exercise intervention in a group of healthy young adults could be increased simply by informing subjects that the exercise program was specifically designed to improve psychological well-being. **(Desharnais, R. et.al., 1993)**

The study for CTS, the yoga-based regimen was more effective than wrist splinting and no supplementary treatment control in relieving some symptoms and signs **(Garfinkel, M S. et.al., 1998)**

La forge, (1997) revealed that Mind-body practice with existing health promotion and cardiac rehabilitation services can improve the self-efficacy and long-term adherence to healthy behaviors. It can as well improve the personal stress management skills. There are also numerous primary and secondary preventive indications for cardiovascular disease (CVD) where the mind-body exercise plays a primary or complementary role.

Barnes et.al., (2001) demonstrated that transcendental meditation program had improvements in cardiovascular reactivity. He also observed the significant reductions in resting systolic blood pressure (SBP) in adolescents with high normal BP.

The beneficial effects of yoga at rest and during stressful states were reflected as reduction in the reactivity of blood pressure, heart rate, and cardiac output to simulated stressors. Successful cardiovascular risk factor modification using a "**Kriya**" yoga program was also achieved by **Schmidt, T. et.al., (1997)**

Ives, J C. et.al., (2000) suggested that mind-body exercise methods are now used widely in the health, fitness, and rehabilitation fields. Yoga helps to reduce stress, decrease hypertension, and also exerts cardiorespiratory benefits.

Yank et.al., (2007) reviewed papers to find out the effects of yoga intervention especially on the common risk factors of chronic diseases like overweight, hypertension, high glucose level and high cholesterol. A systematic search yielded 32 articles published between 1980 and april 2007 which revealed that the yoga interventions are generally effective in reducing body weight, blood pressure, glucose level and high cholesterol.

Kiecolt, G.et.al., (2010) observed that the stress factors like serum interleukin (IL)-6 levels and C-reactive protein (CRP) are higher in the novices than the yoga experts. It is found that IL-6 promotes CRP Production. The yoga experts produced less lipopolysaccharide-stimulated IL-6 in response to the stressor than novices.

Smith et.al., (2011) concluded that yoga when practiced in a more integrated form, i.e., with an ethical and spiritual component provides additional benefits over yoga than when practiced as an exercise regimen.

Innes, K E. et.al., (2007) study suggests that chronic stress and related psychosocial factors also play an important role in the development and progression in the pathogenesis of cardio vascular diseases. Integrated psychological and physiological components of health, yoga and other traditional mind-body therapies may offer particular promise in both the primary and secondary prevention of CVD.

Yoga and meditation has also been commonly used for muscle relaxation. **(Ghoncheh, S, & Smith, J C, 2004).**

Yoga can be performed by most people, including young people and cardiac patients **(Ades, P A. et.al., 2003),(Tran, M. et.al., 2001), (Raub, J, 2002) (Dash, M, & Telles, S, 2001).** Yoga builds up a core stability during and after pregnancy **(Berk, B, 2001)** and it increases the creativity and reduces stress**, (Khasky, A D, Smith, J C, 1999)** as well as to improve muscle power, dexterity, visual perception, **(Raghuraj, P, & Telles, S, 1997)** and reaction time **(Madanmohan et.al.,1993)** while strength, endurance, and muscle reaction times which have been quantified previously, but little has been done to quantify the muscle use during yoga practice **(Narayan, R. et.al., 1990), (Dostalek, C. et.al., 1979)**

Table-1 Distribution of Studies on Autonomic Variable and Yoga for Wellbeing

Distribution of Studies on Autonomic Variable and Yoga for Wellbeing

S. No.	Measured Variables	Reference (Year)	Treatment Variable (Yoga)	Psychological Wellbeing	Autonomic Wellbeing	Physiological/ Organic Wellbeing
1	Heart rate variability	A. G. Ramakrishnan,H. R. Nagendra et al. (Oct. 1998)	Kapalbhati and Nadi shodana	√	√	√
2	Respiratory Movements, Blood pressure and ECG	A. Jr. Stancák,M. Kuna et al.(1991)	Kapalbhati	√	√	√
3	Autonomic activation	C James Corby,T. Roth Walton et al. (May, 1978)	Tantric yoga meditation	√	√	√
4	Autonomic and EEG	Frederick. Travis (Aug. 2001)	Transcendental Meditation practice		√	√
5	Hearth rate variability	Friedman,Lisa Nicole(June .-2002)	Zen breath meditation	√	√	√
6	Autonomic balance	H. S. Nayar,N. T. Joseph et al.(Jan.1983)	Yoga (General)		√	√
7	Cold pressure test and Deep breathing differences	K. Udupa,A. B. Bhavanani et al.(July. 2002)	Shavasan	√	√	√

8	Weight, Blood pressure ECG and EEG	M. Satyanarayana,K. R. Rajeswari et al.(Apr. 1992)	(Santhi Kriya) breathing and relaxation	√	√	√
9	Blood Pressure, ECG and Respiration	M. Kuna,Srinivasan et al.(Oct. 1991)	Kapalbhati		√	√
10	Heart rate variability	Mc. Craty, Craty, Rollin et al.(1993)		√	√	√
11	Hemispheric stimulation	R. G. Bickford,D. Shannahoff-Khalsa (1987)	Nostril breathing	√	√	√
12	Autonomic patterns	R. Keith. Wallace, (1997)	Respiratory suspensions		√	√
13	Metabolism and Autonomic activities	R. Nagarathna,H. R. Nagendra(1994)	Nostril breathing		√	√
14	Oxygen consumption, Blood pressure Pulse volume and Skin resistance	R. Nagarathna,H. R. Nagendra(1996)	Anuloma viloma pranayama		√	√
15	Heart rate variability	R. Raghuraj,H.R. Nagendra et al.(1998)	Kapalbhati and Nadi Suddhi		√	√
16	Cardiac Parasympathetic Tone	S. Takeuchi,J. Hayano(1994)	Relaxation training		√	√
17	Autonomic and Respiratory variables.	Shirley. Telles,(Jan. 2003)	Sirsasana		√	√
18	Metabolism and Autonomic activities	Shirley. Telles,R Nagarathana et al.(1994)	Pranayam (General)		√	√
19	Cardiac Autonomic balance	T.N. Sathyaprabha,P. Satishchandra et al.(February. 2008)	Yoga		√	√

20	Sympathetic activity	U. S. Ray,S. Mukhopadhyaya et al.(Jan. 2001)	Yoga (General)	√	√	√
21	Autonomic Activity of Heart	Varun Malhotra,OP Tandon et al.(2009)	Suryanadi Anuloma Viloma Pranayama	√	√	√
22	Sympathetic activity	VempatiS.Telles et.al.(Apr. 2002)	Yoga (General)		√	√
23	Heart rate variability	Y. Sato W. Kubota,M. Toichi et al.(Apr. 2001)	Zen breath meditation		√	√
24	Heart rate variability	Yuji. Sasaki,Yoshihiro. Saito(Nov/Dec 1999)	Meditation		√	√

3.2.3 Yoga and Hemiplegia

Yoga is a mind-body practice **(Bower, J E. et.al , 2014), (Wahbeh, H. et.al., 2008**) that originated in India (**DiBenedetto, M. et.al.,2005), (Tran, M D. et.al., 2001)** with roots that date back to at least 2000 BC

Yoga is a science and art of healthy living. The primary concern of traditional yoga practice was personal enlightenment. The pratice of yoga and meditation according to the current study demonstrates statistically encouraging physiological and psychological improvements in the neurological disorders. **(Shri K. Mishra et.al., 2012)**

According to WHO, yoga belongs to the Complementary and Alternative Medicine (CAM) field, as a form of non-medication therapy **(WHO, 2002)**

Recent evidence highlights the positive effects of yoga for people with an increased risk of cardiovascular disease **(Cramer, H. et.al.,2013)** and as an add-on therapy for treating the carpal tunnel syndrome **(O'Connor, D. et.al., 2003),** depression, **(Uebelacker, L A. et.al., 2010),** primary prevention of cardiovascular disease. **(Hartley, L. et.al., 2012)**

A recent non-Cochrane systematic review concluded that, in stroke rehabilitation, yoga can be used as a self-administered practice, due to its alleged effect of relieving the mind and body from stress. Yoga was found to act on both the psychological and physical levels, and immense improvements were noted in self-efficacy and confidence level. These changes may lead to a change in the behaviour with improvement in health. **(Lazaridou, A. et.al., 2013)**

Julie, V, Bastill & Kathleen, M, Gill-Body, (2004) conducted a study on the effect of Yoga on poststroke hemiparesis which revealed improvement in TMB(Timed Movement Battery) Scores and BBS (Berg Balance Scale) Scores confirming that yoga may be beneficial to people who have had a stroke.

It is also known that yoga is a good training technique for muscle relaxation. It also reduces anxiety **Platania-Solazzo, A. et.al., (1992)** and has been shown to decrease neurological reaction time and improve muscle strength and endurance of the expiratory and abdominal muscles **(Madanmohan et.al., 1993)**

3.2.4 Sukshma Vyayama (Joint exercises)

The pawanmuktasana series is one of the most important series of practices that has a very profound effect on the human body and mind and is thus a most useful tool for the yogic management of various disorders and maintenance of health. It is one of the special contributions of Bihar School of Yoga and the teachings of Paramahamsa Satyananda.

In Sanskrit these practices are referred to as **Sukshma vyayama** which means 'subtle exercise'. The Sanskrit word pawan means 'wind' or 'prana'; mukta means 'release' and asana means 'pose' or ‘posture’. Thus, pawanmuktasana are a group of asanas which helps mainly to remove any blockages that prevent the free flow of energy in the nadis or channels in the body and also through the energy channels of mind. Sometimes, the energy becomes blocked due to wrong or bad posture, disturbed bodily functions, psychological or emotional problems or an imbalanced or unhealthy lifestyle. Some of the major discomforts are stiffness, muscular tension, lack of proper blood flow and some minor functional defects. If however, these blockages become chronic, it may lead to the malfunctioning or disease of the limb, joint or physical 21 organ. Regular practice of pawanmuktasana promotes total health, regulating and stabilising the flow of energy throughout the body.

Pawanmuktasana is divided into three distinct groups of asanas: the anti-rheumatic group, the digestive/abdominal group and the shakti bandha or energy block group. All three groups supplement each other, stimulating and encouraging a free flow of energy throughout the body.

This group of asanas is concerned with loosening up the joints of the body. It is excellent for those with rheumatism, arthritis, high blood pressure, heart problems or other ailments where vigorous physical exercise is not advised. It is particularly useful for eliminating energy blockages in the joints and outer extremities of the physical body, and works on the pranic and mental bodies as well.

The practices may be performed in three ways:

- With awareness of the actual physical movement
- With awareness and integrated breathing
- With awareness of the movement of prana in the body

After every two or three movements, sit quietly in the base position with the eyes closed and be aware of the natural breath, of the part or parts of the body that have just been moved, and of any thoughts or feelings that come into the mind. After a minute or so continue the practice. This will not only rest the body but will also develop awareness of the internal energy patterns, and the mental and emotional processes.

Some of the Sukshma Vyayama Practices are:

- Padanguli Naman (toe bending)
- Goolf Naman (ankle bending)
- Goolf Chakra (ankle rotation)
- Janu Naman (knee bending)
- Mushtika Bandhana (hand clenching)
- Manibandha Naman (wrist bending)
- Manibandha Chakra (wrist joint rotation)
- Kehuni Naman (elbow bending)
- Skandha Chakra (shoulder socket rotation)
- Greeva Sanchalana (neck movements)

Benefits:

- All the asanas given for foot and calf helps in returning the stagnant lymph and venous blood, thus relieving the tiredness and cramp, and also prevents venous thrombosis especially in the bedridden and post-operative patients.
- The knee joint is an important weight bearing joint of the body which as such has no strong muscles for its support, is the most vulnerable joint for injuries, sprains and osteoarthritis. Thus all the knee asanas strengthen the quadriceps muscle and the ligaments around the knee joint. These practices rejuvenate and

revitalize the joint by activating the healing energies by hastening a proper blood supply and drainage.

- Neck is the region through which all the nerves connecting the different organs and limbs of the body pass by. Therefore, strain or tension gets lodged or accumulated in the muscles of the neck and shoulders, especially after a prolonged desk work or continuous sitting or other bad postures. The yoga practices done for the neck, shoulders and arms release tension, heaviness and stiffness in these areas. **(Swami Satyananda saraswati, 2002, P 21- 44)**

The study conducted by **Shambhu Prasad Shaw & Ravi Kulkarni, (2009)** on the Effect of Sukshma-vyayama on School Children revealed that the important tool to improve the strength and concentration of students is by practicing the Yogic Sukshma-Vyayama. 64 students were allotted to two groups, one as the experimental group while the other as control group. The 32 students in the experimental group practiced yogic sukshma-vyayama in sequence along with some basic yogic practices while the 32 students followed their usual school routine programs and not the Sukshma-vyayama practice in the control group. This training program lasted continuously for 21 days. The yoga group followed some sukshma-vyayama practices related to hand-grip strength where there was a significant change in the right hand grip-strength ($p=0.018$, paired samples t-test); while no change observed in the hand grip-strength in the left hand ($p=0.274$). For control group, there showed no changes in

both the hand grip-strength; while p=0.536 for the right hand and p=0.419 for the left hand (Paired sample t-test).

3.2.5. Nadishodhana Pranayama (NSP)

Patanjali, the father of yoga, described pranayama as the gradual unforced cessation or expansion or exercising of breath. Pranayama is derived from two sanskrit words- prana (life) or ayama (control). Pranayama or control of prana or life force controls ones heart beat pulse and mind **(Sri Paramhansa Yogananda, 2002, P 496 - 507).** The process of pranayama involves systematic and disciplined inspiration and expiration with retention of breath or holding of breath in specific proportion and specific manner for a specific duration. **(Nalini Sharma and Shri Ram Sharma, 2008)**

According to the verse in **Patanjali Yoga Sutra (2:49)** Pranayama means,

"Tasmin sati shvasa prashvasa yorgati vicchedah pranayama" which means that once harmony with the physical body has been achieved, through interruption of the movement engendered by inhaling and exhaling one attempts to harmonize the energy.

In ancient Indian yoga books, lots of pranayamas are described to various benefits. These are bhastrika, kapalbhati, anuloma viloma, bhramari, ujjayi, sheetali, sheetkari, nadi shodhana, etc.

By knowing to control the breath, one can gain control over the emotions and other mental states as well. By becoming aware of the breath, one can gradually become more sensitive to the subtle objects like our mind and to the flow of energy throughout the body and a stronger energy awareness develops within us. How one breathes has an impact on the heart, brain and nervous system. There exists a direct correlation between the breath and anxiety or well-being. During stress, the breath is shorter, more frequent and quite shallow which maintains a level of arousal. Slower and deeper breathing results in a more relaxed state via autonomic reflexive stimulation and decreases the partial pressure of carbon dioxide in the lungs and bloodstream resulting in a corresponding increase in the pH of the blood, where it becomes less acidic hastening an effective blood oxygen synthesis. It also benefits in the metabolism and functioning of brain. For example, deep breathing practices increases the levels of noradrenalin, a compound that functions as a hormone and as a neurotransmitter in the nervous system. **(A, Jr Stancak and M, Kuna, 1994)**

Nadi Shodhana Pranayama or Alternate nostril breathing, which activates and harmonizes ida and pingala nadis. Shodhana means ‗to purify'.

In English this breathing practice is called as Nadi purification pranayama.

Baddhapadmāsano yogī prānam chandrena pūrayet |

Dhārayitvā yathāśakti bhūyah sūryena rechayet ||

Prānam sūryena chākrshya pūrayedudaram śanaih |

Vidhivatkumbhakam krtvā punaśchandrena rechayet ||

Yena tyajettena pītvā dhārayedatirodhatah |

Rechayechcha tatoanyena śanaireva na veghatah ||

Hatha yoga pradipika (2/7, 8, 9)

Meaning: Adopting baddha padmasana, the yogi inhales through the left nostril and holds the breath to their capacity, and then exhales through the right nostril. Then inhaling gently through the right nostril, gradually fill the abdomen, performing kumbhaka as before, and then exhaling completely through the left nostril.

(Swami Muktibodhananda, 2008)

Nadi shodhana pranayama (alternate nostril breathing) affects the cerebral hemisphericity of brain by alternately stimulating the right-brain and then the left-brain passing through the corpus callosum. The process is done by the action of the air flowing through the nostrils that stimulates the contra-lateral (opposite) side of the brain through the nerve endings underneath the nasal mucosa in the nostrils.

Each side of the body is governed by nerves originating in the opposite side of the brain, and stimulating the airflow in one nostril increasing nervous activity in the brain on the opposite side to that nostril. Each side of the brain performs different activities and processes, the autonomic nervous system will also be stimulated and relaxed correspondingly via the Nadishodhana pranayama.

(A, Jr, Stancak and M, Kuna, 1994)

Increasing the flow of air through the right nostril stimulates the sympathetic nervous system thereby increasing the heart rate, producing more sweat, dilating the pupils and opening up the lungs, i.e. the fight or flight reaction. Increasing the flow of air through the left nostril stimulates the parasympathetic nervous system thereby increasing the digestion, lowering the heart rate and relaxing the body. So, by practising the nadi shodhan pranayam, there occurs a balance between both of these systems and helps in balancing the brain activity. **(D, Shannahoff - Khalsa and B, Kennedy, 1993)**

Dandekar Pradnya Deepak, 2013 conducted a study on the short-term training of Anulom-Vilom in Healthy Volunteers and found that few minutes daily practice of Anulom-Vilom Pranayam had significant effect on Systolic Blood Pressure, good positive effect on digestive power and mental freshness and also helps to distress humans at their work places and also help in maintaining better physical and mental health. (**Dandekar Pradnya Deepak, 2013)**

Pallav Sengupta, (2016), postulates that mind-body exercise such as yoga couples sustained muscular activity with internally directed focus, producing a temporary self-contemplative mental state. This triggers the neuro-hormonal mechanisms that brings about healthier benefits, evidenced by the sympathetic activity suppression. Thus, yoga reduces stress and anxiety, improves autonomic and higher neural center functioning and even improves physical health of cancer patients. He concluded that yoga can be beneficial in the prevention and cure of diseases.

3.2.6. AUM Chanting

The AUM chanting practice in a rhythmic way by concentrating on the breath is a traditional way of the powerful means in calming down the mind and helping in enhancing the memory. According to Upanishads, Om is the name or symbol of God **(Chinmayanada Swami, 2002)**. AUM is a combination of three letters, namely, A, U, and M. These syllables represent the past, the present, and the future and also the three planes of being. (**Sivananda Swami, 2005)**.

AUM is the force behind all positive thoughts or vibrations and chanting or even thinking about AUM will bring about the inner silence or a quiet mental state or peace. **(Sanjay Kumar et.al., 2010)**

Bhagavad Gita describes AUM as the Brahman or consciousness and he who remembers it always, attains the supreme goal (**Madhusudhan Saraswati & Gambhiranada Swami, 1998).**

Patanjali's Yoga Sutra (PYS), which is a world famous, reputed and a legendary classical yoga text explained AUM as the Pranava or Pranava mantra and that is Iswara **(Taimini, I K, 1986).**

One of the most common diseases in the world is hypertension and persistent hypertension causes cardiovascular diseases. **(Kearney, P M. et.al., 2005)**

It was reported that, the chanting of 'AUM' reduces heart rate, blood pressure, mental agitation and the skin resistance (**Telles, S. et.al., 1995) Telles, S. et.al., 1998).** Earlier studies reported that, effective 'AUM' chanting causes resonance or vibration around the ears, which is transmitted through the auricular branch of the vagus nerve and stimulates it thereby relaxing the body and mind **(Kraus, T. et.al., 2007).** Vagal nerve stimulation is one of the most common treatment for depression. **(Nahas, Z. et.al., 2005)** (**Jobst, B C, 2010)** Some studies performed earlier reported that Om chanting deactivates limbic system. **(Kalyani, B G. et.al., 2011)**

Medical treatment of hypertension is not always effective to achieve blood pressure control but there are some other practices which can actually do that . **(Saxena, T & Saxena, M, 2009)**

Yogic mantras and prayers have been found beneficial for maintaining many physiological and psychological functions of the body **(Bernardi, L. et.al., 2001**). Om chanting is an important exhalation exercise, **(Saxena, T & Saxena, M, 2009)** and significantly improves pulmonary functions in healthy subjects. (**A, Mooventhan and Vitthal Khode, 2014)**

A study conducted on the Beneficial effects of AUM chanting on depression, anxiety, stress and cognition in elderly women with hypertension by **Arati Amin et.al., (2016)** where they found that, by following six months of AUM chanting practice, the systolic and diastolic pressure, pulse rate, depression, anxiety and stress decreased significantly. MMSE (The Mini Mental State Examination) scores improved significantly followed by Om chanting.

During the AUM chanting practice, our mind focuses only on the repetition of AUM chanting which helps us to reach a state of mental steadiness and provides calm and peace to the stressed mind. **(Ajay Anil Gurjar et.al., 2016)**

3.2.7. Nadishudhana Pranayama and AUM Chanting

Dr. Kanchan Joshi, (2012) conducted a study on the Effect of Nadishodhana Prayayama and Om chanting on Memory Enhancement of College Students. He concluded that the yoga package with nadishodhana Pranayama & Om chanting caused significant memory enhancement of college students.

3.2.8. Deep Relaxation Technique (DRT)

It is a part by part relaxation by directing the attention of mind on different parts of the body starting from the toes and ending with the head, a feeling of relaxation is propagated. Total time duration is 6 minutes. It works at all levels namely; physical, pranic, mental, emotional, intellectual and spiritual **(Dr.H R, Nagendra & Dr.R, Nagarathna , 1986)**

Ghanshyam Singh Thakur et.al., (2009) did a study to find the Effect of DRT (Deep Relaxation Technique) on the capacity to influence REG (Random Event Generator) and found that DRT and SR (Supine Rest) will not invoke the psycho kinetic power in human beings.

MATERIALS

AND

METHODS

4.0 MATERIALS AND METHODS

4.1 Subjects

A total of 75 subjects of spastic hemiplegic men with ages ranging between 30 – 60 years participated in the study.

4.1.1 Description of the subjects including the selection of samples:

The study subjects were conveniently recruited from the Government Yoga & Nature Cure Hospital, Arumbakkam, Chennai District of Tamilnadu State in India. The Subjects were recruited from the above mentioned hospital through screening done to assess diagnostic criteria, inclusion and exclusion criteria. Seventy-five participants were screened through a routine medical check-up and those satisfying the Diagnostic criteria for Obesity were recruited for the study.

4.1.2 Demographics

Table No.2. Describes the demographic details of the subjects

	Experimental Group	**Control Group**
Age[Mean ± SD]	48.60 ± 4.86	46.52 ± 6.89
Gender distribution	40 Males (n=33), 7 males drop out	35 Males (n=31), 4 males drop out
Total Participants completing the study	33	31
Ages range	30 – 60 years	

4.2 Ethical Considerations

4.2.1 Ethical Clearance

Ethical clearance was sought from the Institutional Ethics Committee prior to the start of the study and the approval for the same was granted.

4.2.2 Written Informed Consent

Subjects who fulfilled inclusion criteria were appraised about the purpose of the study and their rights as research subjects. Informed consent form was administered in English. As all the subjects were almost illiterates, there was a requirement of translating the signed informed consent form into native language i.e., Tamil. Adequate time was given to each patient to go through the information sheet and their queries were answered. Their right to withdraw anytime from the study and the need for willingness to participate voluntarily in the study was explained. All the subjects expressed their willingness to participate in the study by giving a signed informed consent. After obtaining informed consent, they will be subjected to a battery of Motor Nerve Conduction test using RMS Aleron Electromyography, (Version 1.1, April 2014) in the Institute of Government Yoga and Naturopathy Medical College.

Fig: 5 RMS Aleron Electromyography (Version 1.1, April 2014)

Fig: 6 Screen showing the graph of Motor Nerve Conductivity

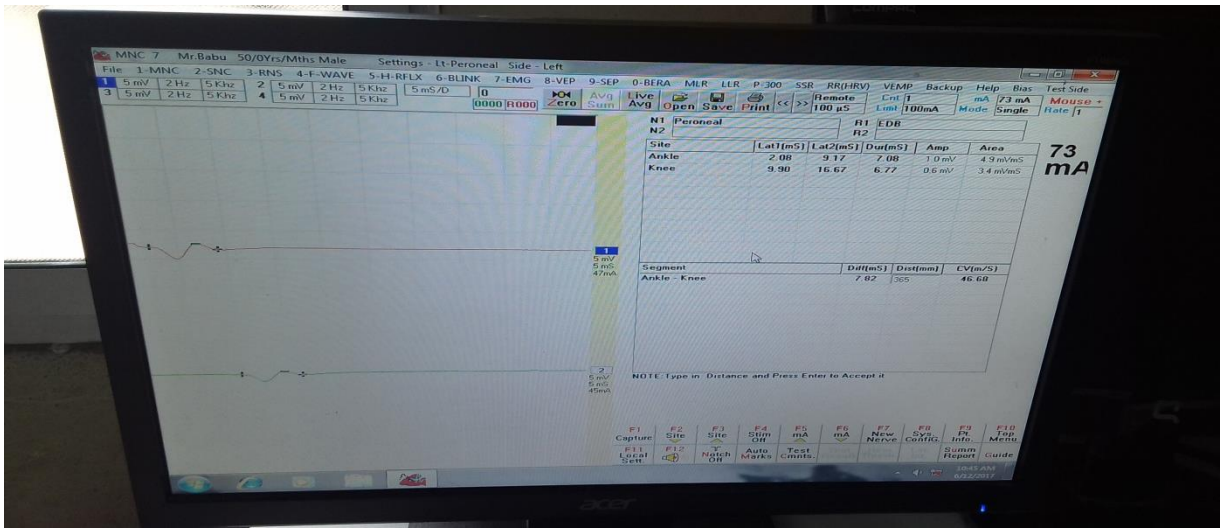


Fig: 7 Getting Informed Consent from the Hemiplegic Patient

(A sample of information sheet and consent form is enclosed as Annexure)

4.3 Screening of Subjects

4.3.1 Criteria for Diagnosis:

The Motor Nerve Conduction test is to measure the nerve conduction velocity of the Median nerve and Peroneal nerve. The distance between the recording electrodes is divided by the difference in the latency between the dorsal and the base response to calculate conduction velocity.

Fig: 8 Calculation of Nerve Conduction Velocity

Calculation of nerve conduction velocity

$$\text{Conduction velocity} = \frac{\text{total length of reflex pathway (in metres)}}{\text{reflex time (in seconds)}}$$

4.3.2 Inclusion and Exclusion Criteria

4.3.2.1 Inclusion Criteria

The following inclusion criteria would be the basis for selecting the subjects

1. Aged between 30-60 years
2. Only Spastic Hemiplegic men will be included for the study
3. Hemiplegic Patients on Allopathy/AYUSH treatment
4. Hemiplegia since 6 months to 2 years
5. Patients who have no severe cognitive and communication impairment
6. Patients who can control urine and bowel
7. Patients having the capacity to sit erect

4.3.2.2 Exclusion Criteria

Participants will be excluded if they had:

1. Accident history
2. Current alcoholic and smoker
3. Peripheral Neuropathy
4. Facial Palsy

4.4 Design

4.4.1 Type of the design

A Prospective Controlled Trial with control group

4.4.2 Convenient Sampling

The patients who satisfied the Inclusion and Exclusion criteria were conveniently grouped into Experimental and Control groups as per the patient availability and period of stay.

4.4.3 Allocation of patients into study & control groups

The patients were allocated conveniently to Study group or Wait Control group.

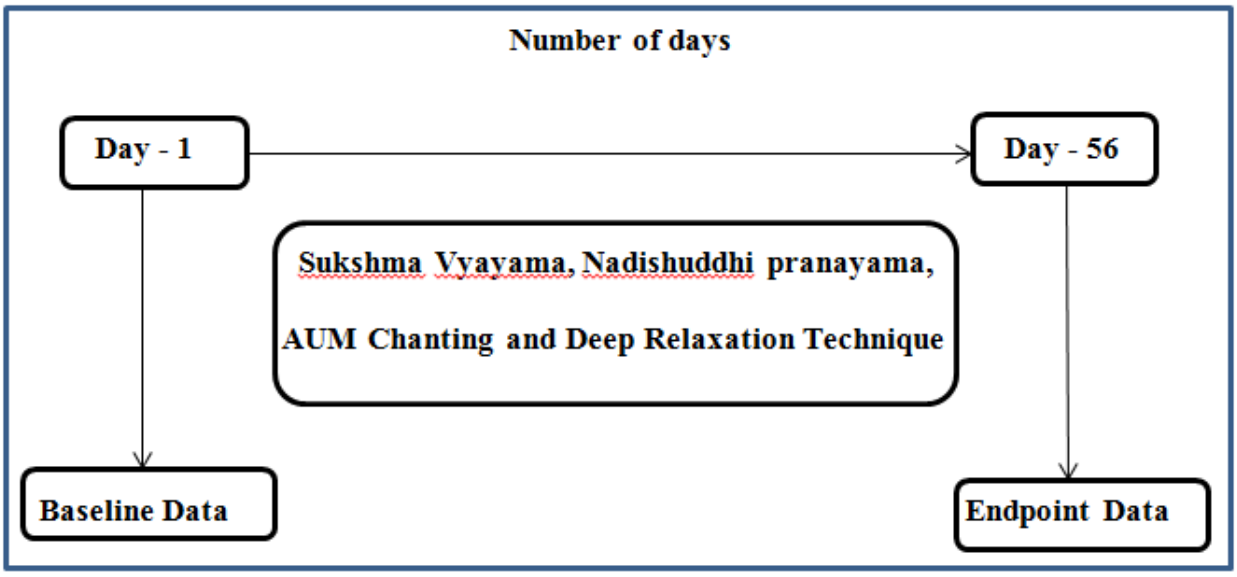
Seventy five subjects were initially screened and assigned to two groups

i.e., Experimental group (n=40) and Wait list control group (n=35)

4.4.4 Data Points

The data collection was done before (day 1), and after (day 56) the intervention.

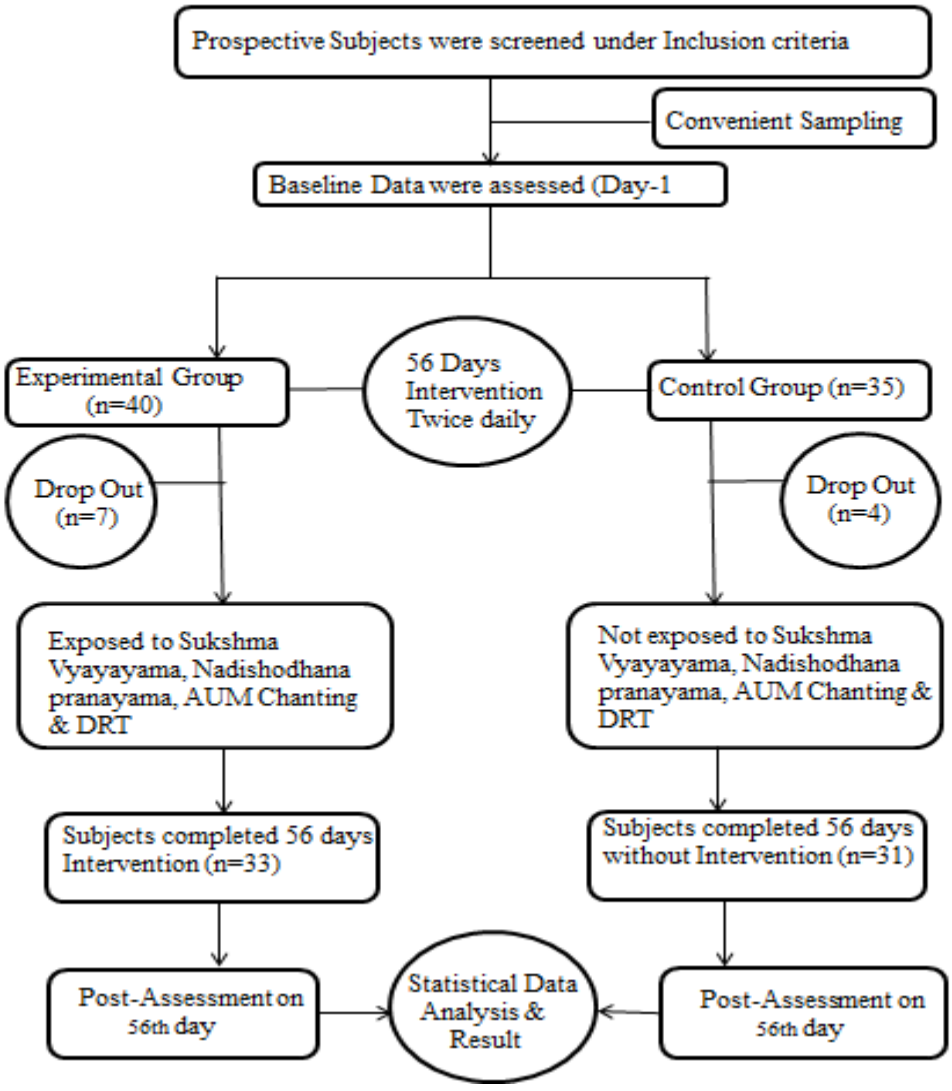
Figure 9: Illustration of Data Points



4.4.5 Trial Profile

The trail profile of the study is presented as Figure 4 which illustrates the study plan; flow of patients across data points and reasons for the drop out.

Figure 10: Trail Profile



4.5 Assessments

The baseline and post-intervention assessments consisted of:

Table 3: List of Primary and Secondary outcome variables

PRIMARY OUTCOME VARIABLES	**SECONDARY OUTCOME VARIABLES**
Motor Nerve Conductivity of Median Nerve	Resting Cardio-Vascular Parameters
Motor Nerve Conductivity of Deep Peroneal Nerve	BMI

4.5.1.1 Nerve Conduction Velocity

Nerve conduction velocity is an important aspect of studying about the nerve conduction. It is the speed or velocity at which an electrochemical impulse propagates down a neural pathway. Some factors like age, sex, and various medical conditions affect the Conduction velocities.

The Conduction velocities vary to each individual and depend largely on an axon's diameter and the degree to which that axon is myelinated, but the majority of 'normal' individuals fall within defined ranges.**[Nerve conduction velocity, National Institutes of Health, 31 October 2013, Retrieved 13 November 2013]**

Nerve impulses are extremely slow compared to the speed of electrical impulses which are on the order of 50–99% of the speed of light, however, very fast compared to the speed of blood flow, with some myelinated neurons conducting at speeds up to 120 m/s (432 km/h or 275 mph).

Normal impulses in peripheral nerves of the legs travel at 40–45 m/s, and 50–65 m/s in peripheral nerves of the arms **(Parry, Gareth, J, 2007).** Largely generalized, normal conduction velocities for any given nerve will be in the range of 50–60 m/s.**[Nerve Conduction Study, Johns Hopkins Medicine, Retrieved 17 November 2013]**

4.5.1.1.1 Testing Methods

Nerve Conduction Velocity is just one of many measurements commonly made during a nerve conduction study (NCS). The purpose of these studies is to determine whether nerve damage is present and how severe that damage may be.

Nerve conduction studies are performed as follows: **[Nerve Conduction Study, Johns Hopkins Medicine, Retrieved 17 November 2013]**

The active & passive electrodes are placed on the subject's skin over the nerve to be tested.

- The stimulator passes the electrical impulses which are sent through one electrode to stimulate the nerve.
- The second electrode records the impulse which are then sent through the nerve as a result of stimulation.
- The time difference between the stimulation from the first electrode and pick-up by the downstream electrode is known as the latency period. Nerve conduction latencies are typically on the order of milliseconds.

The conduction velocity itself is not directly measured, but by calculating the conduction velocities from NCS measurements is trivial. The distance between the stimulating and receiving electrodes is divided by the latency period which gives the value of nerve conduction velocity.

The functional unit of the muscle contraction is a motor unit, comprised of a single alpha motor neuron and all the fibers it enervates. This muscle fiber contracts when the action potentials (impulse) of the motor nerve which supplies it reaches a depolarization threshold. The depolarization generates an electromagnetic field and the

potential is measured as a voltage. The depolarization, which spreads along the membrane of the muscle, is a muscle action potential (**Basmajian, J V. et.al., 1975).**

The motor nerve is stimulated atleast at two points, or at the sites along its course. The pulse is adjusted to record a compound muscle action potential (CAMP). The surface recording electrodes are commonly used and placed in belly tendon of the muscle; keeping the active electrode close to the motor point and the reference one close to the tendon. Ground electrode is placed between stimulating and recording electrodes. Surface stimulation of healthy nerve with an intensity of 5 – 40mA is given. However, in a diseased nerve, the nerve excitability is reduced and the current requirement may be much higher than normal. Filter setting for motor nerve conduction study is 5Hz to 10 kHz and sweep speed 2 to 5ms/division.

For **Median motor nerve** conduction study, the recording electrode is placed close to the motor point of abductor pollicis brevis and the reference electrode about 3 Cm distal from the first metacarpophalangeal joint. A supra maximal stimulation is given at wrist (3Cm proximal to the distal wrist crease) and at elbow (near the volar crease of the brachial pulse). The distal latency, nerve conduction velocity of different segments, and compound muscle action potential amplitudes are measured at different levels following the stimulation. The normal values of median motor nerve conduction are; 57.7 ± 4.9 m/s in Elbow according to Kimura and 58.52 ± 3.76 m/s in Elbow.

For **Deep peroneal motor nerve** conduction study, the active surface electrode is placed over the digitorum Brevis, reference surface electrode is placed over the base of little toe and ground surface electrode is placed over the dorsum aspect of foot. The Nerve Conduction Velocity of Common peroneal nerve below the knee segment is between 48.3 ± 3.9 m/s **(U K, Misra & J, Kalita, 2006)**

Fig: 11 Median Motor Nerve Conduction Test

Fig: 12 Peroneal Motor Nerve Conduction Test

4.5.2 Secondary outcome variables

4.5.2.1 Heart rate

The R waves from the electrocardiogram are detected, to obtain a point event series of successive R-R intervals, from which the beat to beat heart rate series are computed. The heart rate is obtained based on R-R inter-beat interval analysis. The heart rate in beats per minute (bpm) was obtained by continuously counting the QRS complexes in successive 60 s periods.

4.5.2.2 Respiratory Rate

Respiration was recorded using a volumetric pressure transducer fixed around the trunk at the level of the lower costal margin as the subject sit erect. Care is taken to adjust the strap such that full inhalation is not restricted. Breath rate is calculated in cycles per minute (cpm) by counting the breath cycles in 60 second epochs, continuously.

4.5.2.3 Blood pressure

Blood pressure was recorded before and after the cold spinal bath by using a standard mercury sphygmomanometer, auscultating over the right brachial artery. The systolic pressure was noted as the first clear tapping sound (korotkoff sounds) and diastolic pressure was noted as the reading at which the korotkoff sounds appeared muffled.

4.6 Intervention

4.6.1 Test Intervention

The patients in the experiment group were trained in the proper practice of

Sukshma Vyayama, Nadi Shodhana Pranayama, AUM Chanting and DRT on first day and was made to practice for a period of 56 days once daily. (Preferably morning or evening)

4.6.1.1 Procedure of Test Intervention

4.6.1.1.a. Sukshma Vyayama

Siting in a comfortable pose one should perform the 10 practices of Sukshma Vyayama slowly without haste and in coordination with the breathing. Regular practice of pawanmuktasana series-1 removes the so-called energy blockages from the body and prevents new ones from forming. In this way, it promotes total health, regulating and stabilizing the flow of energy throughout the body **(Swami Satyananda saraswati ,2002, P- 21&22)**

4.6.1.1.b Nadi Shodhana Pranayama

Sit in a comfortable posture preferably on the floor over a yoga mat. With the right hand thumb, close the right nostril and breathe in slowly and fully through the left nostril, exhale through the right, inhale through the right and exhale through the left. This is one round. Subjects should perform at the ratio of 1:1. (For example, breathe in for a count of 5 and breathe out for a count of 5). While practicing, be sure that the head and body are on the same line and erect. If the right arm becomes tired, support the elbow in the left palm. Practice ten rounds. (**Swami Muktibodhanada, 2008)**

4.6.1.1.c. General description about Nada anusaandhana

Here different sounds like 'A', 'U', 'M' and 'AUM' are produced loudly so that they generate a fine vibration or resonance all over the body. This resonance sounds act as stimulations and the post-resonance silence deepens the awareness and releases even the very subtle tensions **(Dr.H R, Nagendra, Dr.R, Nagarathna, 2011)**

4.6.1.1.d. General description about Deep Relaxation Technique (DRT)

It is part by part relaxation by directing the attention of mind on different parts of the body starting from the toes and ending with the head, a feeling of relaxation is Propagated. Total time duration is 6 minutes. It works at all levels namely; physical, pranic, mental, emotional, intellectual and spiritual **(Dr.H R, Nagendra, Dr.R Nagarathna, 1986)**

4.6.1.1.e. Counseling

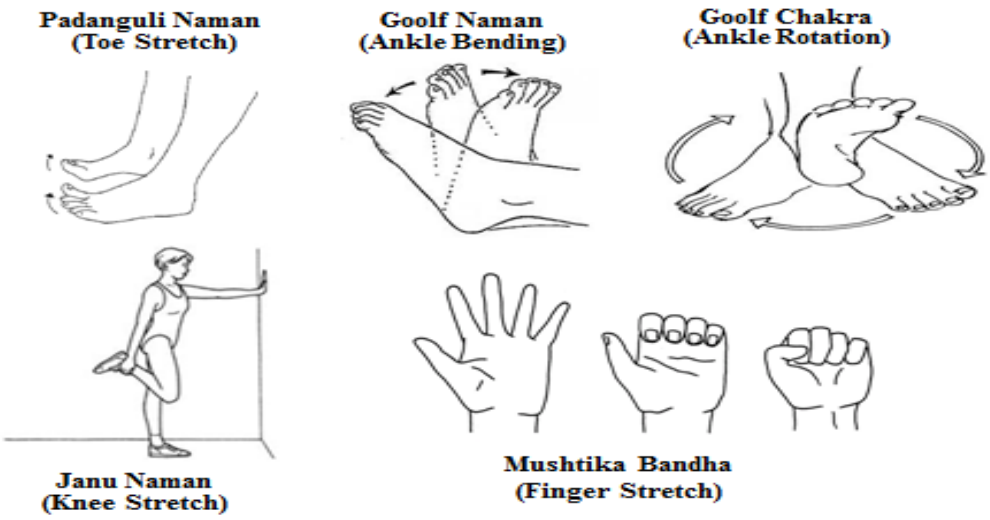
It is the act of helping the client to see things more clearly, possibly from a different view-point which enables one to focus on feelings, experiences or behavior, with a goal to facilitate positive change with trust. It is the activity of giving mental support, assistance, advice and guidance, especially on personal problems and difficulties.

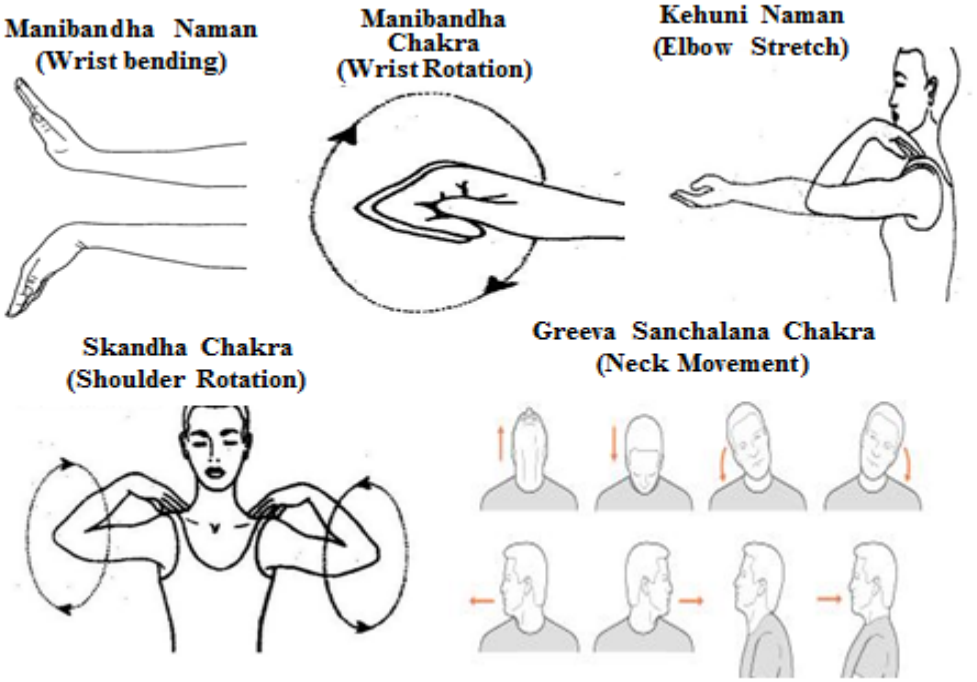
Table 4: Intervention Chart

S.NO	YOGIC PRACTICE		DURATION
1.	Sukshma Vyayama	1. Padanguli Naman (toe stretch) 2. Goolf Naman (ankle bending) 3. Goolf Chakra (ankle rotation) 4. Janu Nanam (Knee Stretch) 5. Mushtika Bandana (Finger Stretch) 6. Mani Bandha Nanam (wrist bending) 7. Mani Bandha Chakra (Wrist Rotation) 8. Kehuni Nanam (elbow Stretch) 9. Skandha Chakra (Shoulder Rotation) 10. GreevaSanchalana (Neck movement)	10 rounds of each practice for 3 mins. (30 minutes totally)
2.	Pranayama	Nadishodhana Pranayama	15 rounds (5 mins)
3.	Nada anusaadhan	'A', 'U', 'M' & 'AUM' chanting	10 chantings of each mantra (5 mins totally)
4.	Relaxation Technique	Deep Relaxation Technique	10 to 20 mins

Fig: 13 Yoga Intervention for the Experimental Group

Sukshma Vyayama

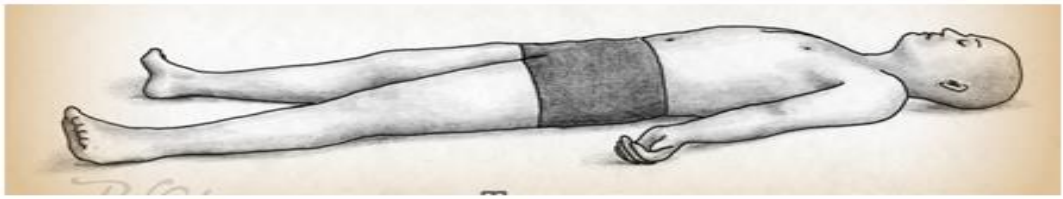




Nadi shodhana
Pranayama

AUM Chanting
Nadaanusaandhana

Deep Relaxation Technique



4.6.2 Control Intervention

The control group were under other AYUSH treatments except Yoga for 56 days. They were also offered to be trained in the experiment intervention if interested after the study.

4.7 Data extraction & analysis

4.7.1 Data Extraction

The data was collected as self-reported observations using primary outcomes and secondary outcome variables. The assessments were done on the first day (baseline data) and end of 56th day (post data). The data was organized in Microsoft Excel Sheets (Version 2010).

4.6.2 Data Analysis

Data expressed as Mean and SD. Inter group and intra group comparison of mean was done by paired and unpaired t test using R statistical software version 3.1.1.

RESULTS

AND

OBSERVATIONS

5.0 RESULTS

Table 5: Anthropometric Variables between Yoga and Control Group

Anthropometric Variables	Yoga n=33	Control n=31	P value
Age (yrs)	48.60±4.86	46.52±6.89	0.69
Height (cm)	166.1±5.26	164.7±4.88	0.62
Weight (kg)	64.55±9.89	64.16±10.41	0.83
BMI (kg/m^2)	23.38±3.11	23.63±3.319	0.79

BMI- Body mass index.

Table 5 shows the anthropometry parameters in yoga group and control group. In both the groups, all the parameters like Age (48.60±4.86 yrs *vs* 46.52±6.89 yrs), height (166.1±5.26 cm *vs* 164.7±4.88 cm), weight (64.55±9.89 kg *vs* 64.16±10.41) and BMI (23.38±3.11 kg/m^2 *vs* 23.63±3.319 kg/m^2) were not showing a significantly (P>0.05) difference and they were considered for the comparison.

Table 6: Resting Cardiovascular Parameters before and after between Yoga and Control Group

Cardiovascular parameters	Yoga		P value	Control		P value
	Before	After		Before	After	
HR (bpm)	78.0±2.23	78.06±2.09	0.9	78.52±3.86	76.39±3.32	0.03
SBP (mmHg)	122.1±14.53	117.6±10.23	***0.01***	125.8±15.23	125.2±12.88	0.69
DBP (mmHg)	78.79± 9.27	77.58±7.91	0.42	80.32±11.10	79.68±6.57	0.67
PP (mmHg)	43.33±10.21	40.0±7.07	0.12	45.48±10.68	45.89±8.50	0.98
MAP (mmHg)	93.23±10.22	90.91±8.13	0.07	95.48±11.60	94.84±8.24	0.57
RPP (bpm-mmHg)	9525±1160	9178±835	***0.03***	9890±1377	95554±1025	0.05
DoP (bpm-mmHg)	5403±1832	4748±1137	***0.04***	5829±1912	5787±1568	0.87

Data Expressed Mean±SD. In depended and paired t.test was used to compare the intergroup and intra group differences. SBP, Systolic blood pressure; DBP, diastolic blood pressure; HR, heart rate; PP, pulse pressure; MAP, mean arterial pressure; RPP, rate pressure product; DoP, double product.

There was no significant difference found in control group patients. After 56 days of intervention, Yoga group patients showed a significant ($P<0.05$) reduction in the resting cardiovascular parameters such as SBP from 122.1±14.53 to 117.6±10.23 mmHg, RPP from 9525±1160 to 9178±835 bpm-mmHg and DoP from 5403±1832 to 4748±1137 bpm mmHg. It clearly showed they were shifted to the status of parasympathetic domination.

Table 7: Motor Nerve Conductivity before and after between Yoga and Control Group

Nerve Conduction velocity (NVC)	Yoga (n=31)		P value	Control (n=33)		P value
	Before	After		Before	After	
Median nerve (msec)	55.63±5.05	53.09±5.61*	***0.02***	50.64±16.13	50.75±9.18	0.97
Peroneal nerve(msec)	45.52±7.89	41.59±5.47**	***0.05***	48.26±5.57	46.41±5.34	0.14

** compared with after yoga and control. * P<0.05, ** P<0.01, *** P<0.001.*

Yoga group patients showed a significant (P<0.05) shortening of nerve conduction velocity after 56 days of yoga intervention compared to control group patients (P>0.05). In yoga group, median nerve conductivity was significantly reduced from 55.63±5.05 ms to 53.09±5.61 ms reflecting a positive improvement. Peroneal nerve conductivity also shortened from 45.52±7.89 to 41.59±5.47 msec in yoga group patients after yoga intervention but there was no significant changes found in control group patients.

Fig: 14 Median Nerve Conductivity between Yoga and Control group

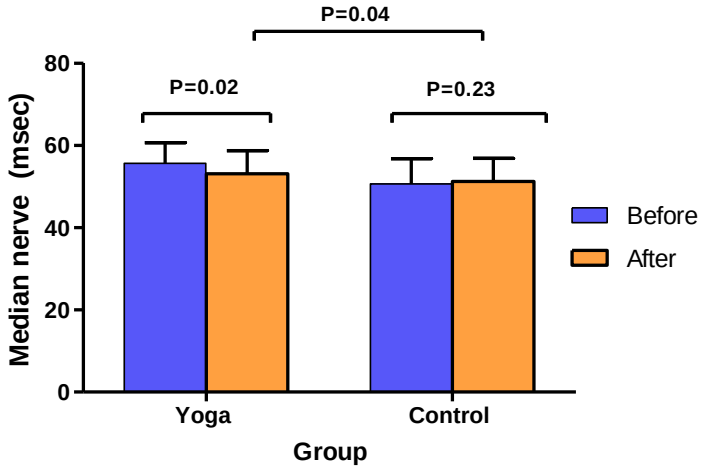


Fig: Median nerve conductivity between Yoga and Control group

Fig: 15 Peroneal Nerve Conductivity between Yoga & Control group

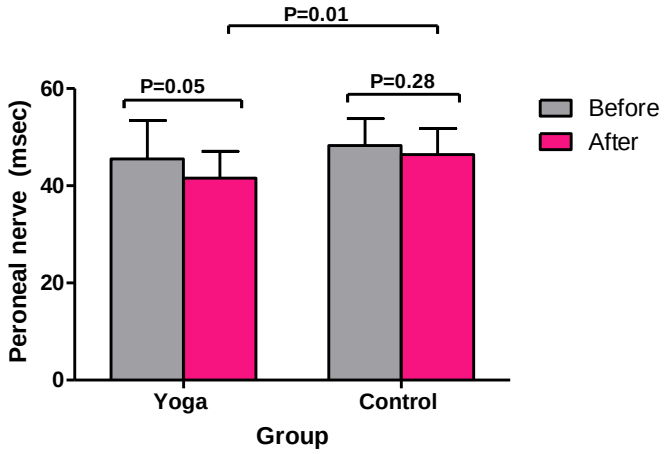
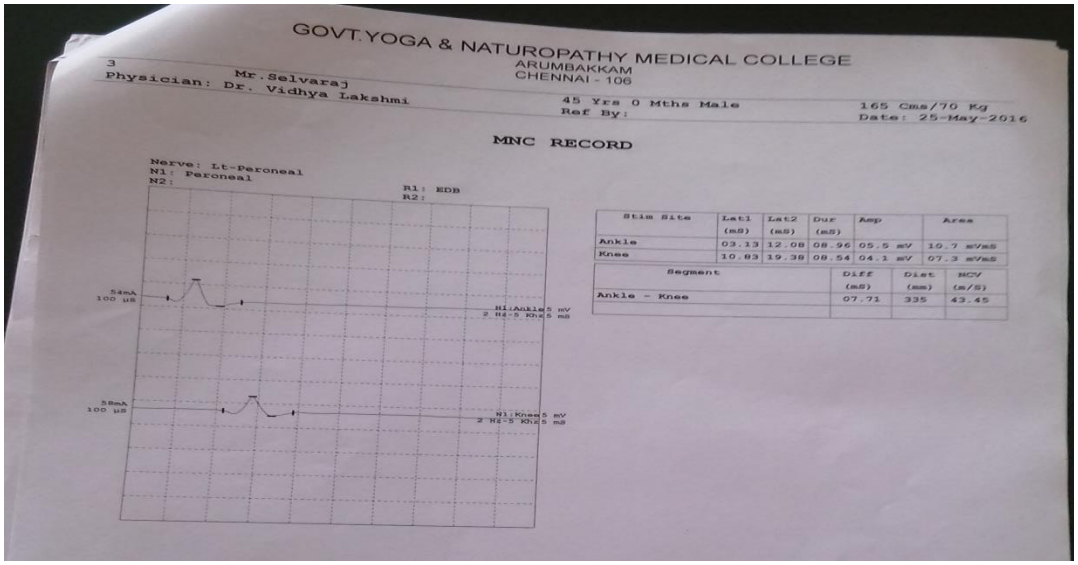


Fig: Peroneal Nerve conductivity between Yoga and Control group

Fig: 16 Report of Peroneal Nerve Conductivity



GOVT.YOGA & NATUROPATHY MEDICAL COLLEGE
ARUMBAKKAM
CHENNAI - 106

3 Mr.Selvaraj
Physician: Dr. Vidhya Lakshmi
45 Yrs 0 Mths Male
Ref By:
165 Cms/70 Kg
Date: 25-May-2016

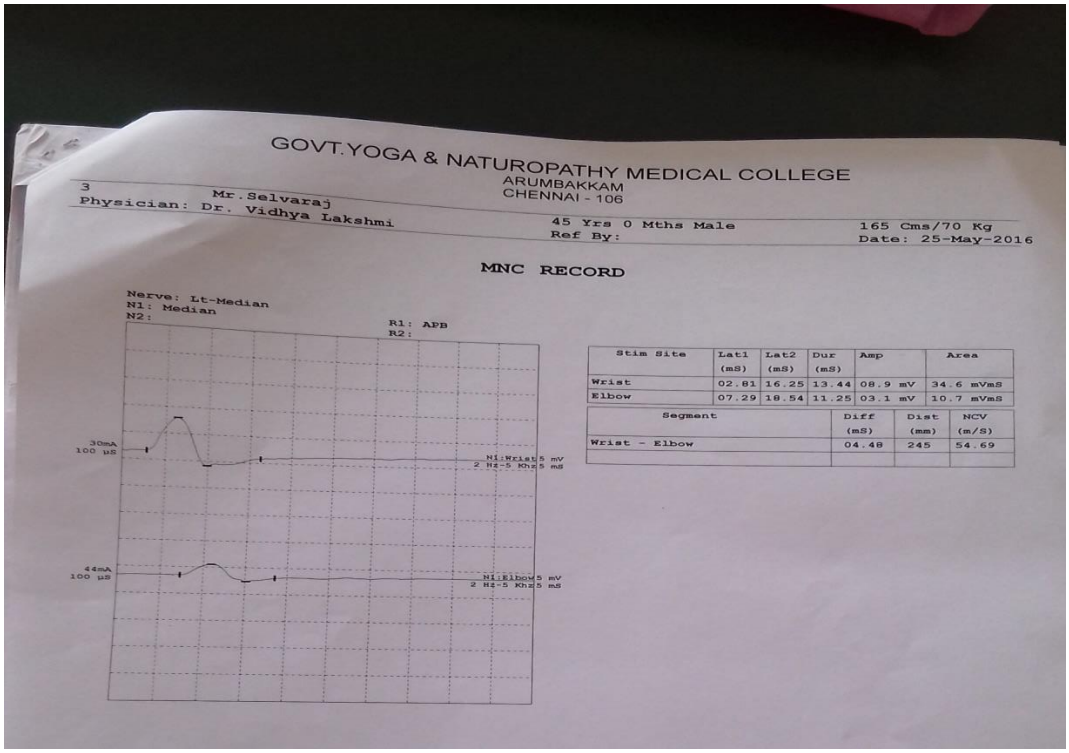
MNC RECORD

Nerve: Lt-Peroneal
N1: Peroneal
N2:
R1: EDB
R2:

Stim Site	Lat1 (mS)	Lat2 (mS)	Dur (mS)	Amp	Area
Ankle	03.13	12.08	08.96	05.5 mV	10.7 mVmS
Knee	10.83	19.38	08.54	04.1 mV	07.3 mVmS

Segment	Diff (mS)	Dist (mm)	NCV (m/S)
Ankle - Knee	07.71	335	43.45

Fig: 17 Report of Median Nerve Conductivity



GOVT.YOGA & NATUROPATHY MEDICAL COLLEGE
ARUMBAKKAM
CHENNAI - 106

3 Mr.Selvaraj
Physician: Dr. Vidhya Lakshmi
45 Yrs 0 Mths Male
Ref By:
165 Cms/70 Kg
Date: 25-May-2016

MNC RECORD

Nerve: Lt-Median
N1: Median
N2:
R1: APB
R2:

Stim Site	Lat1 (mS)	Lat2 (mS)	Dur (mS)	Amp	Area
Wrist	02.81	16.25	13.44	08.9 mV	34.6 mVmS
Elbow	07.29	18.54	11.25	03.1 mV	10.7 mVmS

Segment	Diff (mS)	Dist (mm)	NCV (m/S)
Wrist - Elbow	04.48	245	54.69

DISCUSSION

6.0 DISCUSSION

This Prospective Controlled study was designed to look for differences in the Motor Nerve Conductivity of Median nerve and Peroneal nerve and Cardio-respiratory parameters between Spastic Hemiplegic Men in Government Yoga and Naturopathy Hospital, Chennai. The Result of this study revealed that a combined practice of Sukshma Vyayama, Nadishodhana pranayama, AUM chanting and DRT improved the Motor nerve conductivity and Cardio-respiratory parameters in the experimental group significantly in comparison to that of the control group. In this study there is a significant difference ($p<0.05$) within the experimental group in the MNC of Median Nerve ($p<0.02$) and Peroneal Nerve ($p<0.05$) at the end of the 56th day in comparison to their baseline data. Yoga group patients showed a significant ($P<0.05$) reduction in the resting cardiovascular parameters such as SBP, RPP and DoP. It clearly showed they were shifted to the status of parasympathetic domination.

Similar results were found in another study conducted in the Management of Chronic Hemiplegia patients through Clinical Yoga techniques which revealed improvement in memory recall, proprioception, motor function in both limbs and in expression in activity of Daily Living. Clinical Yoga helps in opening up some of the motor areas which were idle due to lack of stimulation. **(Dr K V, Dilipkumar & Dr P K, Narayana Sarma, 2000)**

Electrophysiological investigations done in hemiplegic patients were well documented in many reports **(Meredith J et.al, 1981), (Ring H et.al, 1993), (Chino N, 1981), (Ring H et.al, 1993)**

Milanov, I, (1995) who evaluated the motor conductivity in median, ulnar, peroneal and tibial nerves found that the mean wave amplitudes were significantly decreased for each nerve study, in both the upper and lower limbs of the paralyzed limbs, when compared to the healthy side. In contrast, the mean motor conduction velocities were not reduced in the unaffected limbs. In our study, both the upper limb and lower limb showed improvement after the intervention. Wasting of muscles in patients after lesions of the upper motor neuron, can be a major cause for reduced conduction velocity **(Takebe, K. et.al., 1975)**

Mc Comas, A J. et.al., (1971) described a possible mechanism for muscle atrophy following upper motor neuron lesions. We believe that a decreased diameter of the nerve fiber as a result or cause of muscle atrophy, could lead to a decreased nerve conduction velocity in the hemiplegic patients.

Basal HR is mainly determined by parasympathetic nervous system (PNS) and DBP is depends on the status of peripheral vascular resistance (PVR) which is mainly altered by sympathetic nervous system (SNS). MAP refers to mean pressure throughout the cardiac cycle and it is determined by both SNS and PNS. Decrease DBP, and MAP represents increase in parasympathetic and decrease in sympathetic activity in yoga group.

RPP and Do*P* represent sympathetic activity and they are indirect measures of O_2 consumption and work load on heart. Rise in PP with decreased RPP indicates that the tissue perfusion is increased with decreased work load on heart in yoga group hemiplegic patients.

Takebe et.al., (1975) did a study on 27 hemiplegic patients and noted the significant slowing of peroneal nerve conduction velocities in the affected extremities. A significant difference in skin temperature between the extremities of the two sides was also noted at the same time. They found that muscle atrophy due to a decreased diameter of the nerve fiber could lead to decreased nerve conduction velocity.

Chokroverty, S and Medina, J, (1978) measured bilaterally the motor nerve conduction velocities of the CPN in 44 hemiplegic patients and found a statistically significant difference between the two limbs. In 63% of the patients skin temperature was reduced in the hemiplegic limbs.

We shall adopt the hypothesis that continuous inversion position, as in hypotonic drop foot, may affect the electro-physiological properties of the nerve. It most probably results from nerve traction and compression at the level of the peroneal neck, causing demyelinization and even axonopathy. Myelin loss results in slowing of nerve conduction through the area involved. When compression is severe, ischemic changes occur and cause secondary axonal damage, expressed by reduction of CMAP amplitude. Nonetheless, we must take into consideration that the slowing of conduction velocities of the CPN in the hemiplegic limbs may be related also to the lowering of the skin temperature and nerve axonal compression in the same limbs.

A study conducted on the experience of stroke which can have a negative impact on both psychological and physical health and on quality of life showed that Yoga and relevant practices were promising therapies that have been used with patients with a variety of conditions. Yoga and mindfulness are the self- administered intervention options for stroke rehabilitation and proven to be clinically valuable.

(Lazaridou, A. et.al., 2013)

The practice of yoga and meditation demonstrates statistically encouraging physical function, physiological and psychological improvements in the neurological disorders and thus yoga is an integrative, alternative, and complementary therapy (**Mishra, S K. et.al., 2012)**

Another study conducted by (**Mishra, S K. et.al., 2012)** confirmed that Yoga resulted in significant improvements in exercise capacity and a mean improvement in HRQL (Health Related Quality of Life) in Chronic diseases and which may be an useful adjunct to formal rehabilitation programs

Many people who have had a stroke reported a reduced level of activity resulting in an impaired health status. Yoga offers a gentle alternative exercise program which can be easily practiced by people who have had a stroke. The effects of a yoga-based exercise program showed growing evidence with improvements in chronic post stroke hemiparesis people with mobility limitations **(Julie, V, Bastille and Kathleen, M, Gill-Body, 2016)**

A therapeutic yoga intervention following stroke may improve multiple aspects of physical functioning. Thus, Yoga intervention is complementary to the traditional rehabilitation **(Schmid, A A. et.al., 2014)**

Overall, the practice of IAYT for 56 days among spastic hemiplegic men has resulted in the improvement of motor function in both the limbs. It improved their quality of living and they gained confidence. Thus Yoga practices helped to activate the autonomic changes.

CONCLUSION

7.0 CONCLUSION

This study showed that 56 days of IAYT improves the Motor Nerve Conductivity of both the Median nerve and Peroneal nerve in hemiplegic patients. This revealed that yoga practice has significant role in improvement in the neuronal activity which is altered in spastic paralysis patients. Decreases Systolic Blood Pressure, Rate Pressure Product & Double Product showed that increase in the dominance of parasympathetic activity in spastic hemiplegic men. However, the practice of IAYT on Body Composition and Heart Rate has not been much appreciable in these subjects. Further research need in this field with a larger sample size and duration is warranted to reveal accurate changes in this field.

SUMMARY

8.0 SUMMARY

The aim of this study is to establish the effect of yoga on the motor nerve conductivity in the spastic hemiplegic men.

The Autonomic Nervous System has been found to be an important factor in regulating the maintenance of the constant energy storage and utilization. Hemiplegics were found to be stressed, depressed, with insecured feeling and dependency on others for their daily activities causing disturbance in the Autonomic functioning.

Yoga is frequently used as a lifestyle intervention to reduce stress, restore autonomic nervous system balance and other therapeutic purposes. This study has used the integrated approach of yoga therapy as a tool to assess if it had any influence on the autonomic activity in spastic Hemiplegic men.

The disease was found predominant among the non-vegetarians, alcoholics, smokers, hypertensive and hyperlipidemic subjects. It was also found commonly in people of low socio-economic status due to their unhealthy lifestyle and stressful job.

In this study, the yogic intervention was given for 6 days a week for 56days, once daily for an hour. 75 hemiplegics were examined clearly by modern aspects and their age group was between 30-60 years who were trained with the yoga practices. The practices included, 30 mins of Sukshma vyayama, 5 mins of Nadishodhana pranayama, 5 mins of AUM chanting and 10-20 mins of Deep Relaxation Technique. The yoga

group had 40 subjects while 35 were in the control group who did not undergo the Yogic intervention for those 56days.

The 75 subjects were evaluated for baseline and post-interventional using variables like Motor Nerve Conductivity of Median and Peroneal nerves, Cardio-respiratory parameters and BMI.

Statistical Analysis of the data collected was done by the method of unpaired ‘t’ test. Following the analysis of the data, it was shown that there were significant changes in both the Median and Peroneal Motor nerve conduction and reductions in the Systolic Blood Pressure (SBP), Rate Pressure Product (RPP) and Double Product (DoP). No significant changes observed in the Heart rate (HR), Diastolic Blood Pressure (DBP) and Pulse Pressure (PP)

Overall, this study has shown that an integrated practice of Yoga for 56 days promotes the sympathovagal balance or activity.

9.0 LIMITATIONS

The sample size is relatively smaller. Hence, generalizing the study outcomes to a

- The sample size is relatively smaller. Hence, generalizing the study outcomes to a larger population would not be definitely conclusive.
- Study was conducted only on Hemiplegic men.
- MNC was done only on Median and Peroneal nerves.
- Duration of the practice is limited; longer exposure to the practice is needed.
- Room temperature was not maintained during the assessment.
- Diurnal variations might have influenced the results.
- Other naturopathic treatments acted as confounding factors during the study.

  Sampling method is not an proper one to confirm the results

9.1 Directions for future research

- This study should be replicated with a larger sample size.
- Study can be done on Hemiplegic women.
- A Multi arm study comparing subjects having exposure to Yoga, Naturopathy, and combination of Yoga & Naturopathy on Spastic Hemiplegic individuals with longer duration would have been better.

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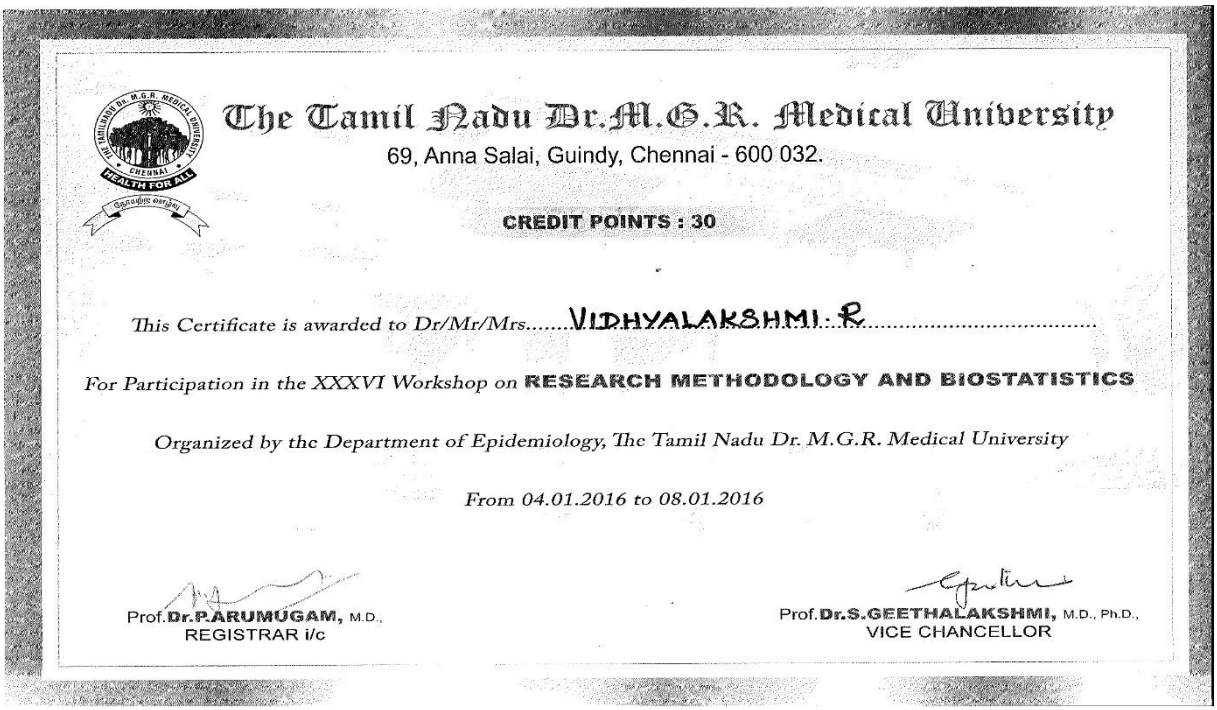
ANNEXURES

CERTIFICATES



The Tamil Nadu Dr.M.G.R. Medical University

69, Anna Salai, Guindy, Chennai - 600 032.

CREDIT POINTS : 30

This Certificate is awarded to Dr/Mr/Mrs..... VIDHYALAKSHMI.R .....

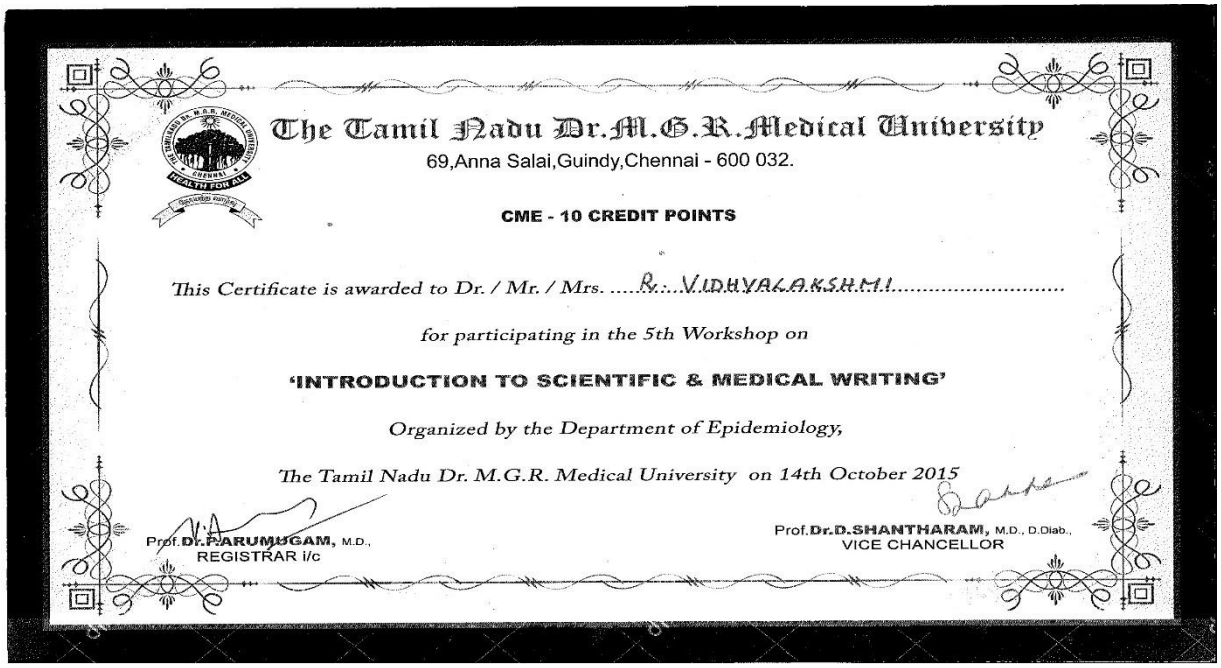
For Participation in the XXXVI Workshop on **RESEARCH METHODOLOGY AND BIOSTATISTICS**

Organized by the Department of Epidemiology, The Tamil Nadu Dr. M.G.R. Medical University

From 04.01.2016 to 08.01.2016

Prof.**Dr.P.ARUMUGAM,** M.D.,
REGISTRAR i/c

Prof.**Dr.S.GEETHALAKSHMI,** M.D., Ph.D.,
VICE CHANCELLOR



The Tamil Nadu Dr.M.G.R.Medical University

69,Anna Salai,Guindy,Chennai - 600 032.

CME - 10 CREDIT POINTS

This Certificate is awarded to Dr. / Mr. / Mrs. ..... R. VIDHYALAKSHMI .....

for participating in the 5th Workshop on

'INTRODUCTION TO SCIENTIFIC & MEDICAL WRITING'

Organized by the Department of Epidemiology,

The Tamil Nadu Dr. M.G.R. Medical University on 14th October 2015

Prof.**Dr.P.ARUMUGAM,** M.D.,
REGISTRAR i/c

Prof.**Dr.D.SHANTHARAM,** M.D., D.Diab.,
VICE CHANCELLOR

Sri Ramachandra University
(Declared under section 3 of the UGC Act, 1956)
Sri Ramachandra Medical College & Research Institute
Department of Physiology

ASSOCIATION OF PHYSIOLOGISTS
TAMIL NADU

SYMMEDCON 2017

International Conference on Stress, Yoga & Mind-Body Medicine

This is to certify that Dr/Mr/Ms. Vidhya lakshmi R. has participated as Delegate in SYMMEDCON 2017, International Conference on Stress, Yoga & Mind-Body Medicine Conducted by Department of Physiology on 2nd & 3rd January 2017 at SRMC & RI.

Credit Hours - 10

Dr. R. Padmavathi	Dr. Venkat Srinivasan	Dr. K.V. Somasundaram
Organizing Chairperson	Organizing Secretary	Dean of Faculties

Sri Ramachandra University
(Declared under section 3 of the UGC Act, 1956)
Sri Ramachandra Medical College & Research Institute
Department of Physiology

ASSOCIATION OF PHYSIOLOGISTS
TAMIL NADU

SYMMEDCON 2017

International Conference on Stress, Yoga & Mind-Body Medicine
Post conference workshop on Autonomic Function Test (AFT), Mind Body Medicine & Yoga

This is to certify that Mr/Ms/Dr. Vidhya lakshmi participated as Resource Person/Delegate in the Workshop Conducted by Department of Physiology on 4th January 2017 at SRMC & RI.

Credit Hours - 6

Dr. R. Padmavathi	Dr. Venkat Srinivasan	Dr. S.T. Venkateswaran	Dr. K.V. Somasundaram
Organizing Chairperson	Organizing Secretary	Convener	Dean of Faculties

10.0 ANNEXURES

Annexure 1: INFORMATION SHEET

INFORMATION SHEET

We are conducting a study "**Effect of IAYT (Integrated Approach Of Yoga Therapy) On Motor Nerve Conduction In Spastic Hemiplegic Men – A Prospective Controlled Trial"** in Government Yoga & Naturopathy Medical College, Chennai- 106.

The purpose of this study is to evaluate the effectiveness of IAYT which may be of use in management of Spastic Hemiplegic male patients.

We need your participation in this study. Here we are assessing the Motor Nerve Conduction, heart rate and blood pressure variations before and after practising IAYT.

The privacy of the patients in the research will be maintained throughout the study. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared. Taking part in this study is voluntary. You are free to decide whether to participate in this study or to withdraw at any time; your decision will not result in any loss of Benefit to which you are otherwise entitled. The results of the special study may be intimated to you at the end of the study period or during the study if anything is found abnormal which may aid in the management or treatment.

Signature of investigator
Signature of participant

Date:

Annexure 2: INFORMED CONSENT FORM

INFORMED CONSENT FORM

Title of the study: "**Effect of IAYT (Integrated Approach Of Yoga Therapy) On Motor Nerve Conduction In Spastic Hemiplegic Men – A Prospective Controlled Trial"**

Name of the Participant:

Name of the Principal Investigator: Dr.R.Vidhyalakshmi

Name of the Institution: Government Yoga and Naturopathy Medical College, Arumbakkam, Chennai – 600 106.

Documentation of the informed consent

I _____ have read the information in this form (or it has been read to me). I was free to ask any questions and they have been answered. I am over 18 years of age and, exercising my free power of choice, hereby give my consent to be included as a participant in "**Effect of IAYT (Integrated Approach Of Yoga Therapy) On Motor Nerve Conduction In Spastic Hemiplegic Men – A Prospective Controlled Trial**"

1. I have read and understood this consent form and the information provided to me.

2. I have had the consent document explained to me.

3. I have been explained about the nature of the study.

4. I have been explained about my rights and responsibilities by the investigator.

5. I have been informed the investigator of all the treatments I am taking or have taken in the past _____ months including any native (alternative) treatment.

6. I have been advised about the risks associated with my participation in this study.

7. I agree to cooperate with the investigator and I will inform him/her immediately if I suffer unusual symptoms.

8. I have not participated in any research study within the past _____month(s).

9. I am aware of the fact that I can opt out of the study at any time without having to give any reason and this will not affect my future treatment in this hospital.

10. I am also aware that the investigator may terminate my participation in the study at any time, for any reason, without my consent.

12. I hereby give permission to the investigators to release the information obtained from me as result of participation in this study to the sponsors, regulatory authorities, Govt. agencies, and IEC. I understand that they are publicly presented.

13. I have understood that my identity will be kept confidential if my data are publicly presented.

14. I have had my questions answered to my satisfaction.

15. I have decided to be in the research study.

I am aware that if I have any question during this study, I should contact the investigator. By signing this consent form I attest that the information given in this document has been clearly explained to me and understood by me, I will be given a copy of this consent document.

For adult participants:

Name and signature / thumb impression of the participant (or legal representative if participant incompetent)

Name_____ Signature_____

Date_____

Name and Signature of impartial witness (required for illiterate patients):

Name _____ Signature_____

Date _____

Address and contact number of the impartial witness:

Name and Signature of the investigator or his representative obtaining consent:

Name _____Signature_____

Date _____

INFORMATION TO PARTICIPANTS

Investigator: Dr.R.Vidhyalakshmi, B.N.Y.S

Name of Participant:

Title: "Effect of IAYT (Integrated Approach Of Yoga Therapy) On Motor Nerve Conduction In Spastic Hemilegic Men – A Prospective Controlled Trial"

You are invited to take part in this research/ study /procedures. The information in this document is meant to help you decide whether or not to take part. Please feel free to ask if you have any queries or concerns.

You are being asked to participate in this study being conducted in

Government Yoga and Naturopathy Medical College,

Arumbakkam,

Chennai – 600 106.

What is the Purpose of the Research?

Hemiplegia is a condition that causes half of the body to be paralyzed (unable to move). It's caused by damage to one half of the brain; specifically, when that damage affects the parts of the brain responsible for motor movements. The half of the body affected depends on which half of the brain has been damaged.

To determine whether the yoga based lifestyle program has a beneficial effect on the management of Hemiplegia.

To determine the effect of IAYT on Motor Nerve Conduction on Median and Deep peroneal nerve.

The Study Design

Seventy-five Male patients with Spastic Hemiplegia of age group between 30-60yrs will participate in the study.

Study Procedures

The study involves assessment of Motor Nerve Conduction Velocity.

You will be required to visit the hospital during the study.

(The test involves Electro Myogram / EMG study before the commencement of therapies and after 56 days.)

You may have to come to the hospital (study site) for examination and investigations apart from your scheduled visits, if required.

Possible Risks to you - Nil

Possible benefits to you- Motor Nerve dysfunction can be diagnosed at an early stage so that proper intervention can be taken.

Possible benefits to other people

The result of the research may provide benefits to the society in terms of advancement of medical knowledge and/or therapeutic benefits to future patients.

Confidentiality of the information obtained from you

You have the right to confidentiality regarding the privacy of your medical information (personal details, results of physical examinations, investigations, and your medical history). By signing this document, you will be allowing the research team investigators, other study personnel, sponsors, IEC and any person or agency required by law like the Drug Controller General of India to view your data, if required.

The information from this study, if published in scientific journals or presented at scientific meetings, will not reveal your identity.

How will your decision to not participate in the study affect you?

Your decisions to not to participate in this research study will not affect your medical care or your relationship with investigator or the institution. Your doctor will still take care of you and you will not lose any benefits to which you are entitled.

Can you decide to stop participating in the study once you start?

The participation in this research is purely voluntary and you have the right to withdraw from this study at any time during course of the study without giving any reasons.

However, it is advisable that you talk to the research team prior to stopping the treatment

Annexure 3 : ஆராய்ச்சி தகவல் தாள்

சென்னை அரசு யோகா மற்றும் இயற்கை மருத்துவமனைக்கு வரும் பக்கவாத நோயாளிகளிடம் மோட்டார் நரம்பு கடத்துதல் என்னும் பரிசோதனை பற்றிய ஒரு ஆராய்ச்சி இங்கு நடைபெற்று வருகின்றது.

பக்கவாதத்தில் பற்பல நரம்புகள் பாதிக்கபடும். அதில் குறிப்பாக,மீடியன் மற்றும் டீப்-பெரோனியல் நரம்புகளை ஆராய்வதே இந்த ஆராய்ச்சியின் நோக்கமாகும்.

நீங்களும் இந்த ஆராய்ச்சியில் பங்கேற்க நாங்கள் விரும்புகிறோம். இந்த ஆராய்ச்சியில் உங்களுடைய மோட்டார் நரம்பு கடத்துதல் பற்றிய பரிசோதனை செய்யப்பட்டு தகவல்களை ஆராய்வோம். அதனால் தங்களது நோயின் ஆய்வறிக்கைக்கோ அல்லது சிகிச்சைக்கோ பாதிப்பு ஏற்படாது என்பதையும் தெரிவித்துக்கொள்கிறோம்.

முடிவுகளை அல்லது கருத்துக்களை வெளியிடும்போதோ அல்லது ஆராய்ச்சியின்போதோ தங்களது பெயரையோ அல்லது அடையாளங்களையோ வெளியிடமாட்டோம் என்பதையும் தெரிவித்துக்கொள்கிறோம்.

இந்த ஆராய்ச்சியில் பங்கேற்பது தங்களுடைய விருப்பத்தின் பேரில்தான் இருக்கிறது. மேலும் நீங்கள் எந்நேரமும் இந்த ஆராய்ச்சியிலிருந்து பின்வாங்கலாம் என்பதையும் தெரிவித்துக்கொள்கிறோம்.

இந்த சிறப்பு பரிசோதனைகளின் முடிவுகளை ஆராய்ச்சியின்போது அல்லது ஆராய்ச்சியின் முடிவின்போது தங்களுக்கு அறிவிப்போம் என்பதையும்தெரிவித்துக்கொள்கிறோம்.

ஆராய்ச்சியாளர் கையொப்பம் பங்கேற்பாளர்கையொப்பம்

தேதி :

ஆராய்ச்சி ஒப்புதல் கடிதம்

ஆராய்ச்சி தலைப்பு :

பெயர் : தேதி :

வயது : உள் நோயாளி எண் :

பால் : ஆராய்ச்சி சேர்க்கை எண் :

இந்த ஆராய்ச்சியின் விவரங்களும் அதன் நோக்கங்களும் முழுமையாகவும் எனக்கு தெளிவாகவும் விளக்கப்பட்டது.

எனக்கு விளக்கப்பட்ட விஷங்களை நான் புரிந்துகொண்டு நான் எனது சம்மதத்தைத் தெரிவிக்கிறேன்.

எனக்கு மோட்டார் நரம்பு கடத்துதல் பரிசோதனை செய்துகொள்ள சம்மதம்.

இந்த ஆராய்ச்சியில் பிறரின் நிற்பந்தமின்றி என் சொந்த விருப்பத்தின் பேரில் தான் பங்கு பெறுகிறேன் மற்றும் நான் இந்த ஆராய்ச்சியிலிருந்து எந்நேரமும் பின்வாங்கலாம் என்பதையும் அதனால் எந்த பாதிப்பும் ஏற்படாது என்பதையும் நான் புரிந்துகொண்டேன்.

நான் மோட்டார் நரம்பு கடத்துதல் பரிசோதனை பற்றிய விவரங்களையும் ஆராய்ச்சியாளர் மூலம் தெரிந்துக்கொண்டேன்.

நான் என்னுடைய சுயநினைவுடன் மற்றும் முழு சுதந்திரத்துடன் இந்த மருத்துவ ஆராய்ச்சியில் என்னை சேர்த்துக்கொள்ள சம்மதிக்கிறேன்.

மேற்கண்ட மோட்டார் நரம்பு கடத்துதல் பரிசோதனையின்போது லேசான மின்சார அதிர்ச்சி ஏற்படலாம் என மருத்துவர் மூலம் தெரிந்துக்கொண்டேன்.

கையொப்பம்

Annexure 4: Socio Demographic Data Sheet

SECTION A

1. ID. No: 2. OP/IP. No:

3. Age: 4. Date:

5. Sex: 6. Religion:

7. Educational status: 8. Occupation:

9. Monthly income: 10. Marital status:

12. Postal address:

a. Landline :

b. Mobile :

SECTION B: ILLNESS DETAILS

13. Duration of illness:

14. History of chief complaints:

15. Treatment:

16. Any medical illness?

Diabetes mellitus/Systemic Hypertension/Seizures/any other specify:

17. Presence of medical illness in the family:

SECTION C: PHYSICAL EXAMINATION

	Baseline	After 56 days
Height (Cms)		
Weight (Kgs)		
BMI		
Pulse rate (Beats/min)		
Resp Rate (Cycles/min)		
Blood pressure (Lying)		

SECTION D: INSTRUMENTS USED

MOTOR NERVE CONDUCTION STUDY

	Baseline	After 56 days
Median Nerve Conduction Velocity		
Peroneal Nerve Conduction Velocity		

ANNEXURE 5: RAW DATA – Control and Experimental Groups

Control Group – Body Composition (RAW DATA)

SI.No	Subjects	Age	Height	Weight (Kg)		BMI	
			(Cms)	Pre	Post	Pre	Post
1	Mr.Seetharaman	60	164	60	60	22.38	22.38
2	Mr.Shanmugam	59	161	61	60	23.55	23.55
3	Mr.Ramesh	35	157	42	42	17.07	17.07
4	Mr.Muralidharan	39	168	72	72	25.53	25.53
5	Mr.Arumugam	50	160	66	66	25.78	25.78
6	Mr.Kaliyugavaradhan	55	162	77	75	29.38	28.62
7	Mr.Shajagan	50	164	62	62	23.13	23.13
8	Mr.Senthil Kumar	34	175	69	69	22.54	22.54
9	Mr.Ravichandran	56	160	56	56	21.87	21.87
10	Mr.Rajasekar	57	167	87	87	31.29	31.29
11	Mr.Kumar.S.M	52	169	66	66	23.15	23.15
12	Mr.Anbu	36	155	64	64	26.66	26.66
13	Mr.Subramaniam.R	60	170	68	68	23.52	23.52
14	Mr.Ezhumalai	50	162	66	66	25.19	25.19
15	Mr.Venugopal	30	162	56	56	21.37	21.37
16	Mr.Sudhakar	55	160	66	66	25.78	25.78
17	Mr.Mahimairaj	39	164	62	62	23.13	23.13
18	Mr.Thangaprakasam	60	160	59	59	23.04	23.04
19	Mr.Ranjith Kumar	41	175	83	83	27.12	27.12
20	Mr.Murugan	43	166	79	79	28.72	28.72
21	Mr.Gajendran	56	168	74	74	26.24	26.24
22	Mr.Zahir Hussain	48	168	62	62	21.98	21.98
23	Mr.V.R.Venkatesan	54	160	58	58	22.65	22.65
24	Mr.Chelladuraipandi	60	168	60	60	21.27	21.27
25	Mr.Devaraj	52	167	54	54	19.42	19.42
26	Mr.Govindasamy	60	165	60	60	22.05	22.05
27	Mr.N.Vedhakiri	59	168	58	56	20.56	20.56
28	Mr.Xavier	58	162	55	55	20.99	20.99
29	Mr.Sathish Kumar	30	171	80	80	27.39	27.39
30	Mr.Raj	53	168	66	66	23.4	23.4
31	Mr Jadayan	60	159	41	41	16.26	16.26

Control Group – Motor Nerve Conduction Velocity (RAW DATA)

SI.No	Subjects	Age	Median MNC		Peroneal MNC	
			Pre	Post	Pre	Post
1	Mr.Seetharaman	60	49.9	50.98	46.28	45.2
2	Mr.Shanmugam	59	52.24	48.04	43.79	42.01
3	Mr.Ramesh	35	53.49	52.35	52.16	44.43
4	Mr.Muralidharan	39	37.85	52.51	45.45	48.04
5	Mr.Arumugam	50	12	11.78	50.35	46.39
6	Mr.Kaliyugavaradhan	55	52.69	47.97	53.33	51.88
7	Mr.Shajagan	50	56.77	55.44	42.77	49.88
8	Mr.Senthil Kumar	34	56	54.9	48	40.81
9	Mr.Ravichandran	56	13.71	46.13	41.14	37.7
10	Mr.Rajasekar	57	92.53	32.42	40.07	41.27
11	Mr.Kumar.S.M	52	49	50.1	46.24	30.23
12	Mr.Anbu	36	60	53.96	55.79	51.23
13	Mr.Subramaniam.R	60	58.04	56.77	42.05	47.47
14	Mr.Ezhumalai	50	59.95	55.8	44.51	43.5
15	Mr.Venugopal	30	58.04	54.28	51.72	51.03
16	Mr.Sudhakar	55	55.04	53.78	49.88	46.84
17	Mr.Mahimairaj	39	56.21	52.4	52.25	47.46
18	Mr.Thangaprakasam	60	64.77	61.43	46.84	43.27
19	Mr.Ranjith Kumar	41	54.9	53.74	45.54	53.18
20	Mr.Murugan	43	11.78	45.38	42.47	46.99
21	Mr.Gajendran	56	51.96	57.86	48.51	38.43
22	Mr.Zahir Hussain	48	61.64	63.323	54.5	58.08
23	Mr.V.R.Venkatesan	54	48.96	47	48.01	53.18
24	Mr.Chelladuraipandi	60	54	51.932	47.47	45.54
25	Mr.Devaraj	52	59.95	52.19	49.87	47.39
26	Mr.Govindasamy	60	52	50.88	44.71	46.33
27	Mr.N.Vedhakiri	59	38.57	43.16	46.78	45.62
28	Mr.Xavier	58	55.44	55.56	48.65	46.8
29	Mr.Sathish Kumar	30	55.56	54.49	47.46	50.95
30	Mr.Raj	53	56.77	55.56	49.62	48.56
31	Mr Jadayan	60	29.93	51.17	69.72	49.1

Control Group – Resting Cardiovascular Variables (RAW DATA)

No	Subjects	Age	HR		SBP		DBP		PP		MAP		RPP		Dop	
			Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	Mr.Seetharaman	60	78	76	130	130	80	80	50	50	96.66666667	96.66666667	10140	9880	6500	6500
2	Mr.Shanmugam	59	76	80	90	110	60	70	30	40	70	83.33333333	6840	8800	2700	4400
3	Mr.Ramesh	35	78	82	100	100	60	60	40	40	73.33333333	73.33333333	7800	8200	4000	4000
4	Mr.Muralidharan	39	78	78	110	100	80	70	30	30	90	80	8580	7800	3300	3000
5	Mr.Arumugam	50	70	78	130	140	90	90	40	50	103.3333333	106.6666667	9100	10920	5200	7000
6	Mr.Kaliyugavaradhan	55	84	80	140	130	90	80	50	50	106.6666667	96.66666667	11760	10400	7000	6500
7	Mr.Shajagan	50	78	72	130	140	100	90	30	50	110	106.6666667	10140	10080	3900	7000
8	Mr.Senthil Kumar	34	78	82	150	140	90	80	60	60	110	100	11700	11480	9000	8400
9	Mr.Ravichandran	56	78	74	140	140	90	80	50	60	106.6666667	100	10920	10360	7000	8400
10	Mr.Rajasekar	57	82	72	130	130	70	80	60	50	90	96.66666667	10660	9360	7800	6500
11	Mr.Kumar.S.M	52	82	78	130	130	80	80	50	50	96.66666667	96.66666667	10660	10140	6500	6500
12	Mr.Anbu	36	80	74	120	120	70	80	50	40	86.66666667	93.33333333	9600	8880	6000	4800
13	Mr.Subramaniam.R	60	86	74	110	120	70	80	40	40	83.33333333	93.33333333	9460	8880	4400	4800
14	Mr.Ezhumalai	50	72	80	100	100	60	70	40	30	73.33333333	80	7200	8000	4000	3000
15	Mr.Venugopal	30	80	74	130	130	80	80	50	50	96.66666667	96.66666667	10400	9620	6500	6500
16	Mr.Sudhakar	55	82	78	140	140	90	90	50	50	106.6666667	106.6666667	11480	10920	7000	7000
17	Mr.Mahimairaj	39	78	80	130	140	100	90	30	50	110	106.6666667	10140	11200	3900	7000
18	Mr.Thangaprakasam	60	78	76	140	140	100	90	40	50	113.3333333	106.6666667	10920	10640	5600	7000
19	Mr.Ranjith Kumar	41	80	78	110	110	80	80	30	30	90	90	8800	8580	3300	3300
20	Mr.Murugan	43	76	78	130	130	80	80	50	50	96.66666667	96.66666667	9880	10140	6500	6500
21	Mr.Gajendran	56	68	74	120	120	70	80	50	40	86.66666667	93.33333333	8160	8880	6000	4800
22	Mr.Zahir Hussain	48	76	68	120	120	80	80	40	40	93.33333333	93.33333333	9120	8160	4800	4800
23	Mr.V.R.Venkatesan	54	80	74	130	130	80	80	50	50	96.66666667	96.66666667	10400	9620	6500	6500
24	Mr.Chelladuraipandi	60	80	76	130	130	80	80	50	50	96.66666667	96.66666667	10400	9880	6500	6500
25	Mr.Devaraj	52	76	72	110	110	80	70	30	40	90	83.33333333	8360	7920	3300	4400
26	Mr.Govindasamy	60	74	76	130	130	90	80	40	50	103.3333333	96.66666667	9620	9880	5200	6500
27	Mr.N.Vedhakiri	59	82	76	140	120	80	80	60	40	100	93.33333333	11480	9120	8400	4800
28	Mr.Xavier	58	80	72	130	130	80	80	50	50	96.66666667	96.66666667	10400	9360	6500	6500
29	Mr.Sathish Kumar	30	82	78	130	120	70	80	60	40	90	93.33333333	10660	9360	7800	4800
30	Mr.Raj	53	80	78	160	140	90	80	70	60	113.3333333	100	12800	10920	11200	8400
31	Mr Jadayan	60	82	80	110	110	70	80	40	30	83.33333333	90	9020	8800	4400	3300

HR- Heart Rate, SBP- Systolic Blood Pressure, DBP- Diastolic Blood Pressure, PP- Pulse Pressure,

MAP- Mean Arterial Pressure, RPP- Rate Pressure Product, DoP- Double Product

Experimental Group – Body Composition (RAW DATA)

SI.No	Subjects	Age	Height	Weight (Kg)		BMI	
			(Cms)	Pre	Post	Pre	Post
1	Mr.Selvaraj	45	165	70	70	25.73	25.73
2	Mr.K.Suresh	38	165	59	58	21.69	21.69
3	Mr.Babu	36	155	65	65	27.08	27.08
4	Mr.Ramesh	50	165	56	53	20.58	19.48
5	Mr.Kumar	35	170	57	57	19.72	19.72
6	Mr.Suresh.M	28	166	55	53	20	19.27
7	Mr.Babu.S	50	165	50	50	18.38	18.38
8	Mr.Sardharkahn	47	167	70	70	25.17	25.17
9	Mr.Mahesh	42	160	65	65	25.39	25.39
10	Mr.Pratap	40	171	80	77	27.39	26.71
11	Mr.Nagaraj.S	57	159	48	46	19.04	18.25
12	Mr.Venkatesan	42	164	60	60	22.38	22.38
13	Mr.Jai Singh	37	166	84	82	30.54	29.81
14	Mr.Balasubramaniam	54	166	76	76	27.63	27.63
15	Mr.Sivakumar	38	170	70	70	24.22	24.22
16	Mr.Gopal	37	171	77	73	26.36	25
17	Mr.Radhakrishnan	46	171	67	64	22.94	21.91
18	Mr.N.V.Kumar	58	171	61	60	20.89	20.54
19	Mr.Krishnan	53	160	61	58	23.82	22.65
20	Mr.Shiva	48	173	68	66	22.74	22.07
21	Mr.Zahir Hussain	44	171	81	80	27.73	27.39
22	Mr.G.Mahalingam	47	158	50	50	20.08	20.08
23	Mr.Dillibabu	36	161	72	72	27.79	27.79
24	Mr.N.Nagaraj	55	176	71	69	22.97	22.33
25	Mr.Lakshmanan	60	164	56	56	20.89	20.89
26	Mr.Loganathan	52	172	67	65	22.71	22.03
27	Mr.A.Kumar	42	164	62	62	23.13	23.13
28	Mr.Perumal	54	163	53	53	20	20
29	Mr.Subramani	50	170	55	55	19.03	19.03
30	Mr.AbdulKareem	43	176	83	83	26.86	26.86
31	Mr.Murali	43	160	59	59	23.04	23.04
32	Mr.Rajendran	60	160	56	56	21.87	21.87
33	Mr.Rajan	54	167	66	66	23.74	23.74

Pre – Baseline Data, Post – Post Interventional Data

Experimental Group – Motor Nerve Conduction Velocity (RAW DATA)

SI.No	Subjects	Age	Median MNC		Peroneal MNC	
			Pre	Post	Pre	Post
1	Mr.Selvaraj	45	54.69	61.87	43.45	51.07
2	Mr.K.Suresh	38	54	63.08	47.47	49.09
3	Mr.Babu	36	53.38	60.34	34.28	33.95
4	Mr.Ramesh	50	48.94	56.92	44.43	51.54
5	Mr.Kumar	35	56.92	52.04	46.21	46.21
6	Mr.Suresh.M	28	50	57.08	46.04	55.91
7	Mr.Babu.S	50	58.23	63.01	46.68	43.25
8	Mr.Sardharkahn	47	51.2	53.78	44.5	50.28
9	Mr.Mahesh	42	53.78	64.38	48.04	47.99
10	Mr.Pratap	40	41.53	50	39.21	46.36
11	Mr.Nagaraj.S	57	48	48.98	37.52	45.36
12	Mr.Venkatesan	42	38.23	51	43.76	43.25
13	Mr.Jai Singh	37	52.15	53.24	42.03	36.6
14	Mr.Balasubramaniam	54	50	51.04	37.67	35.8
15	Mr.Sivakumar	38	55.88	58.16	39.91	35.01
16	Mr.Gopal	37	55	64.4	37.84	44.63
17	Mr.Radhakrishnan	46	68.83	54.08	41.22	41.67
18	Mr.N.V.Kumar	58	49.04	56.92	59.01	49.08
19	Mr.Krishnan	53	52.4	48.98	45.31	44.77
20	Mr.Shiva	48	51.82	52.84	37.93	49
21	Mr.Zahir Hussain	44	55.21	57.86	49.71	47.41
22	Mr.G.Mahalingam	47	56.21	50.1	49.12	49.76
23	Mr.Dillibabu	36	55.29	58.08	48.59	48.03
24	Mr.N.Nagaraj	55	60.5	53	46.93	44.89
25	Mr.Lakshmanan	60	53.57	51.17	59.11	48.57
26	Mr.Loganathan	52	57.57	60.27	50.86	46.94
27	Mr.A.Kumar	42	48.98	59.11	47.96	46.42
28	Mr.Perumal	54	43.97	46.23	32.72	34.48
29	Mr.Subramani	50	55.1	57.57	73.17	46.44
30	Mr.AbdulKareem	43	50.11	48.02	49.25	48
31	Mr.Murali	43	57.57	54	48.52	49.09
32	Mr.Rajendran	60	55.04	60.88	47.39	53.33
33	Mr.Rajan	54	58.89	57.38	36.24	40.21

Experimental Group – Resting Cardiovascular Variables (RAW DATA)

No	Subjects	Age	HR		SBP		DBP		PP		MAP		RPP		Dop	
			Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	Mr.Selvaraj	45	80	76	110	100	70	70	40	30	83.33333	80	8800	7600	4400	3000
2	Mr.K.Suresh	38	80	82	130	120	80	80	50	40	96.66667	93.33333	10400	9840	6500	4800
3	Mr.Babu	36	76	76	130	120	80	80	50	40	96.66667	93.33333	9880	9120	6500	4800
4	Mr.Ramesh	50	82	74	110	110	70	70	40	40	83.33333	83.33333	9020	8140	4400	4400
5	Mr.Kumar	35	78	76	110	110	70	70	40	40	83.33333	83.33333	8580	8360	4400	4400
6	Mr.Suresh.M	28	80	80	120	110	80	70	40	40	93.33333	83.33333	9600	8800	4800	4400
7	Mr.Babu.S	50	78	78	120	120	80	80	40	40	93.33333	93.33333	9360	9360	4800	4800
8	Mr.Sardharkahn	47	76	82	120	110	70	80	50	30	86.66667	90	9120	9020	6000	3300
9	Mr.Mahesh	42	82	80	110	110	70	80	40	30	83.33333	90	9020	8800	4400	3300
10	Mr.Pratap	40	76	78	120	110	80	80	40	30	93.33333	90	9120	8580	4800	3300
11	Mr.Nagaraj.S	57	76	78	130	100	70	70	60	30	90	80	9880	7800	7800	3000
12	Mr.Venkatesan	42	80	80	130	120	80	80	50	40	96.66667	93.33333	10400	9600	6500	4800
13	Mr.Jai Singh	37	80	74	130	120	70	80	60	40	90	93.33333	10400	8880	7800	4800
14	Mr.Balasubramaniam	54	78	80	100	120	70	70	30	50	80	86.66667	7800	9600	3000	6000
15	Mr.Sivakumar	38	78	78	140	130	90	80	50	50	106.6667	96.66667	10920	10140	7000	6500
16	Mr.Gopal	37	82	76	110	110	70	70	40	40	83.33333	83.33333	9020	8360	4400	4400
17	Mr.Radhakrishnan	46	78	80	130	120	80	80	50	40	96.66667	93.33333	10140	9600	6500	4800
18	Mr.N.V.Kumar	58	76	78	150	130	100	80	50	50	116.6667	96.66667	11400	10140	7500	6500
19	Mr.Krishnan	53	72	76	110	120	70	70	40	50	83.33333	86.66667	7920	9120	4400	6000
20	Mr.Shiva	48	76	76	110	110	70	70	40	40	83.33333	83.33333	8360	8360	4400	4400
21	Mr.Zahir Hussain	44	78	78	100	110	70	70	30	40	80	83.33333	7800	8580	3000	4400
22	Mr.G.Mahalingam	47	78	80	100	110	70	80	30	30	80	90	7800	8800	3000	3300
23	Mr.Dillibabu	36	76	78	130	130	100	80	30	50	110	96.66667	9880	10140	3900	6500
24	Mr.N.Nagaraj	55	76	80	110	120	80	80	30	40	90	93.33333	8360	9600	3300	4800
25	Mr.Lakshmanan	60	78	78	120	110	70	80	50	30	86.66667	90	9360	8580	6000	3300
26	Mr.Loganathan	52	76	78	150	130	90	80	60	50	110	96.66667	11400	10140	9000	6500
27	Mr.A.Kumar	42	82	78	150	130	90	90	60	40	110	103.3333	12300	10140	9000	5200
28	Mr.Perumal	54	76	76	110	110	80	70	30	40	90	83.33333	8360	8360	3300	4400
29	Mr.Subramani	50	78	80	120	120	80	70	40	50	93.33333	86.66667	9360	9600	4800	6000
30	Mr.AbdulKareem	43	78	76	150	150	90	110	60	40	110	123.3333	11700	11400	9000	6000
31	Mr.Murali	43	78	76	120	120	90	80	30	40	100	93.33333	9360	9120	3600	4800
32	Mr.Rajendran	60	78	80	130	130	80	80	50	50	96.66667	96.66667	10140	10400	6500	6500
33	Mr.Rajan	54	78	80	120	110	90	80	30	30	100	90	9360	8800	3600	3300